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ACADEMIC AND PROFESSIONAL INCENTIVES

IN its report on "University Finance in Great Britain", dated July 1943, the British Association Committee on Post-War University Education recorded the view that the question of university salaries was the essence of the situation and should be given priority over almost everything else. The salaries of university staffs of all grades were, in the opinion of that Committee, hopelessly inadequate in competition with the world outside, and in the lower ranges, in some universities, inadequate to afford a reasonable standard of life under prevailing social conditions. In the older universities, the salaries of the non-professorial staff were considered not inadequate in the lower ranks, except for the few who devote themselves almost wholly to research. At the provincial universities, however, the average salary of the non-professorial staff was not more than £450–475 a year, as against £600–1,000 for Cambridge (omitting demonstrators and faculty assistant lecturers).

The British Association Committee asserted bluntly that we can expect neither to attract to the university staffs the pick of their graduates nor to have a satisfactory standard of performance on such salaries ; and it recommended an adequate number of senior lectureships and readerships carrying salaries of £700–1,000 a year. Beyond this, however, it was of the firm opinion that in the existing organisation of our society, all whole-time professors in all British universities should receive at least £1,500 a year at 1938 values. "The reputation of our universities," it was urged, "depends more on the quality of their professors than on any other single factor. For the sake of university teaching and research we should make it more easy to retain our very best men, and to attract outstanding men back from the outside world when they are still at the height of their powers."

Somewhat similar proposals were advanced by the Association of University Teachers in a report on "University Developments, 1944", adopted by the Council of the Association in December 1943, namely, a basic salary of £1,500 for professors, and salaries in the range £800–1,100 for senior lecturers and readers. These proposals were afterwards criticized by Bruce Truscot in "Redbrick and these Vital Days", who suggested that the basic salary of £1,500 for a professor was too low though not necessarily at the beginning, and that the British Association Committee's own recommendation implies a basic figure of £1,800. The general level of lecturers' salaries proposed by the Association, however, he regarded as too high ; and he urged that the principle of a salary scale for the professor is of vital importance and one which will be of real service in dealing with the difficulty that in certain subjects such as medicine, and possibly engineering, it may be necessary to pay considerably higher salaries in view of outside competition.

It is true that outside competition should not be the sole factor to be considered in determining

professorial salaries; but it is from this point of view that some recent observations of Dr. C. E. Raven in addressing the Senate of the University of Cambridge, on resigning the office of vice-chancellor on October 1, have received publicity which has somewhat distorted them. Dr. Raven recalled that, when putting forward proposals for the stipends of its professors, the University was warned by the University Grants Committee that £1,450 was the maximum professorial salary which the Treasury would recognize. Dr. Raven said that it seemed plain that if the maximum income in academic life was so seriously below that obtainable not only in medicine and at the Bar, but also in the Civil Service and indeed almost all other professions, the universities could scarcely expect to induce men of the highest abilities to stay with them.

This, however, was not all. If professors were limited to such a rate, and there was to be any ladder of promotion, junior teaching officers could be given scarcely a living wage—certainly not a wage on which to marry and bring up a family. Dr. Raven referred particularly to the position of men who, after six or more years in national service, had gained fellowships or been elected to junior teaching posts, and who at the age of thirty were receiving salaries little different from those offered in 1939 to men of twenty-three. In view of the cost of living, it seemed inevitable that unless the university could improve its scales of pay, it would lose an increasing number of men.

That view, of course, ignores the other incentives which induce men and women to take up an academic life; but such incentives can scarcely operate if the salaries offered in the early years of academic life do not enable men and women to sustain modest standards of living such as those laid down by the Association of University Teachers in the memorandum issued before the War, which presented reasoned arguments for a minimum stipend of £500 for a married teaching officer to do his whole duty by a university and its students. The disparity between such academic salaries and those offered in industry is considerable and may well lead to untoward distribution of man-power if uncorrected. Dr. Raven, indeed, directs attention to one specific example of disparity which was obviously in the mind of the British Association Committee when its report was written; the findings of the Spens Report on the Remuneration of Consultants and Specialists, to which Dr. Raven refers, accentuate this disparity. As Dr. Raven suggests, it is on the face of it absurd that whereas the stipends of the majority of Cambridge professors do not rise above £1,550, a specialist appointed to the staff of a hospital is to be guaranteed a salary rising to £2,500 at the 1939 value of money. If the salaries of university teachers of medicine are raised to the figures specified in the Spens Report, the resulting anomalies in the scientific departments of a university will be intolerable as well as absurd.

The universities are clearly facing something of a dilemma, even if the terms may not be precisely as Dr. Raven suggests. The disparity between the pay of chemists in industry and in the universities is well known, and the professorial limit of £1,450 is a good deal less than a man of the highest ability could expect to earn, even if more laboriously or precariously, in the Civil Service or at the Bar, quite apart from industry or medicine. It has been made abundantly clear in discussions on scientific man-power and on scientific and industrial research during the last decade that any policy which denuded any one sector of national life, whether the universities, the Government service or industry, of its proper proportion of the new talent leaving the universities, would have untoward repercussions on the well-being of the nation as a whole.

The problem or dilemma is thus not one for the universities alone, and it must be considered against a much broader background than that of finance. As regards the latter, it should be noted, moreover, that in a written answer to a question in the House of Commons on November 4, Mr. Glenvil Hall stated that in assessing grants to the universities, the University Grants Committee recognizes certain standard rates of salary for professors (other than clinical professors). Allowances are, however, made to enable institutions to pay higher rates of salary where the institution considers the rate of salary should for any reason be above the standard. The distribution of this additional remuneration is left entirely to the institution concerned.

These arrangements, Mr. Glenvil Hall added, were made after consultation with the Treasury, and they seem to leave the universities rather freer than Dr. Raven implies to compete with the non-academic world on its own terms. It does not follow, however, that the universities are bound to do so, unless there is real evidence that first-class men are deserting the universities in significant numbers to earn high salaries elsewhere. So far as chemists are concerned, the evidence suggests that even the offer of considerably higher salaries is not attracting to industry all the men needed for research or production. Moreover, Dr. Raven's statement that £1,450 is the maximum salary has been challenged elsewhere; in the civic universities, it is stated that the typical range of professorial salaries is £1,450 to £1,750, apart from the full-time clinical professors, who receive £2,500. Even this range of salaries is not much inducement for a highly trained man with great influence in the community at the peak of his career; and it must be admitted that in spite of the rise in the salaries of university teachers since 1939, neither in leisure nor in money are they, and particularly the professors, as well off as they were before the War. Nevertheless, it is reasonable to ask whether the universities actually know of men who would have taken their more important posts had it been possible to offer another two hundred pounds or so. Such evidence is imperative before the universities take any steps to restore the balance between clinical professors and non-teaching specialists, or between clinical and non-clinical professors, which the recommendations of the Spens Report so obviously upset.

Whatever course the universities adopt, even if they fall back on a general upgrading of all professorial salaries, the repercussions are likely to be

far-reaching. Admittedly, comparison between academic salaries and those current in the medical profession is invidious and a poor basis for framing policy. It illustrates, indeed, the embarrassments that may arise from bringing, without careful preparation and forethought, hitherto unplanned and uncoordinated parts of the economy under the ægis of the State. Quite apart from the rise in salaries in a profession already comparatively highly paid given by the institution of the National Health Service, there has simultaneously been a considerable retardation of the operation of the economic factors which would normally restore the balance. Meanwhile, the nation may well find itself in the near future with a plethora of medical and a great scarcity of the scientific workers, technicians and administrators upon whose services industrial productivity and development depend.

The financial incentive is, of course, not the only one. It is often not the most important motive that influences a man or woman in choosing between an academic life or a career in industry, medicine or another profession; but it is essential that at the lower levels, where a difference of two hundred pounds or less may be a decisive factor, the minimum salaries must be such as enable the maintenance of a standard of living compatible with the full discharge of academic responsibilities. The sense of vocation is not entirely lost, and the idea of rendering public service can still influence the choice of profession. Part at least of the immediate task is to dispel the misconceptions which have, for example, made young scientific workers reluctant to enter industry; for few who have gone into modern industry on the research, production or management side have been unable to find satisfaction for their ideal of public service as much as in academic life, the Civil Service or in independent professional practice.

Adequate salaries at the lower levels should be a first consideration in any national policy. If the universities can be satisfied that at those levels there is no longer the risk of some promising scientific worker, for example, who would fill a professorial post with great distinction in a couple of decades if he remained in academic life, being attracted to another career solely on financial grounds, the most important step towards safeguarding the future will have been taken. Nor is the question one for the universities alone. It should also have the attention of the professional bodies, for it is bound up with that question of mobility of staff and the interchange of workers which is now generally recognized as fruitful for creative work. The question of incentives and conditions of work in one particular profession or occupation cannot be considered entirely without reference to those which prevail elsewhere.

These questions need to be examined from a broader angle than has often been done in the past. In a stimulating discussion on the large laboratory in nuclear research at the Princeton Bicentenary conferences, Prof. E. P. Wigner suggested that one important advantage which the university possesses over other institutions is the constant influx of new people to whom the basis of each idea has to be explained and by whom it may be challenged. A comparatively rapid turnover at both the top and the lower levels of at least a part of the staff in a large laboratory or institution might, he suggested, have a vitalizing effect and help to avoid the stagnation which tends to infect such institutions.

Such migration and interchange is, of course, greatly hindered by existing disparities in salary scales, apart from the new tensions which the Spens Report threatens to introduce. Discussions on superannuation schemes have already emphasized the same point, and there are other obstacles such as housing difficulties which are partly financial and partly material. The time is ripe for a broad approach to the whole question from a national point of view. The subject well merits a considered statement by such a body as Nuffield College, giving due weight to the altruism which often determines the choice of profession, as well as to the financial and other material incentives. Such a statement might well be a most important contribution to the solution of the long-term problem of the distribution of the nation's trained man-power in ways which at once afford satisfaction to the idealism and sense of vocation of the individual, and the needs of the community for service in specific fields.

LARGE-SCALE EVOLUTION

Neuere Probleme der Abstammungslehre

D.e Transspezifische Evolution. Von Prof. Dr. Bernhard Rensch. Pp. vii + 407. (Stuttgart: Ferdinand Enke, 1947.) 26.20 R. marks.

DR. JULIAN HUXLEY has already directed attention to this book in a short comment published in *Nature* of October 9, p. 562. It is, as he pointed out, a worthy companion of the series of monographs by Dobzhansky, Simpson, Mayr and Huxley himself, which have in the last few years elevated evolutionary theory to a new plane of precision and completeness. It is particularly interesting to be presented at this time with a general discussion which was written in Germany during the War, when communication with English-speaking men of science was at a minimum. The general similarity between Dr. Bernhard Rensch's conclusions and those of the books mentioned above is very striking, and demonstrates that there is a wide consensus of agreement on the new advances in our understanding.

Rensch's work is mainly devoted to that part of evolutionary theory which has always presented the greatest difficulties of interpretation in the past, namely, the large-scale evolutionary changes which relate widely differing species, genera or families. The argument advanced is that, so far as our present knowledge goes, these can be adequately explained by the three main factors—mutation, selection and chance—which produce the minor diversities within species. The book is introduced by a short summary of the evidence for the action of these factors within species and of the nature of the intra-specific differentiation which they bring about. It then passes on to a discussion of the nature of major evolutionary change, which is classified into two broad categories: kladogenesis, or the branching of evolutionary

lineages so as to give rise to new types; and anagenesis, or progressive evolution within a lineage.

Rensch's main argument can, perhaps, be summarized in two conclusions: first, that nearly all conceivable types of organisation seem actually to have occurred, which is evidence that the processes are fundamentally under the influence of chance mutation; and secondly, that the individuals which undergo evolution are developmental systems possessing an organisation which conditions the types of change that can arise. These theses are supported by a wide selection of facts drawn from a detailed knowledge of systematics—both of recent and fossil forms—and of many branches of genetics and experimental biology. The reader is left in no doubt that the study of evolution remains, as it was in Darwin's day, the prime field of biology, demanding a universality of knowledge and a power of synthesis which must greatly transcend the narrow limits within which too many biologists are content to be confined.

In the last three chapters, Rensch ventures into even wider fields, and enters on a discussion of the origin of life, and of the evolution of consciousness. The arguments advanced here may not meet with so much general acceptance; but the topic is one to which biologists should more often attempt to contribute. Many of the classical problems of epistemology derive from the elementary knowledge of human sensory physiology which was all that was available to authors such as Hume, and they are bound to appear somewhat differently when seen in the light of our present knowledge of the faculties of man's ancestors.

C. H. WADDINGTON

ELEMENTARY ZOOLOGY IN THE UNITED STATES

Laboratory Guide in Animal Biology

By Robert H. Wolcott and Asst. Prof. Eugene F. Powell. (McGraw-Hill Publications in the Zoological Sciences.) Second edition. Pp. ix+113. (New York and London: McGraw-Hill Book Co., Inc., 1948.) 9*s*.

An Introduction to Vertebrate Anatomy

By Harold Madison Messer. Revised edition. Pp. xxi+475. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1947.) 24*s*. net.

A Concise Comparative Anatomy

By William Henry Atwood. Pp. 413. (St. Louis, Mo.: C. V. Mosby Company; London: Henry Kimpton, 1947.) 20*s*. net.

Textbook of Zoology

By Prof. George Edwin Potter. Second edition. Pp. 948. (St. Louis, Mo.: C. V. Mosby Co.; London: Henry Kimpton, 1947.) 25*s*. net.

THESE four text-books for elementary students illustrate the trends in the teaching of zoology in the United States. As three of them are second editions they have obviously proved successful in their own spheres. The "Comparative Anatomy" by Atwood, although in its first edition, is based on the author's "Introduction to Vertebrate Anatomy", and in some degree, therefore, is not entirely new.

Wolcott and Powell's "Laboratory Guide" is similar to the schedules that most university teachers produce as the result of their experience in dealing with large practical classes. It proceeds by the 'types method', using protozoa, a sponge, coelenterates, flatworms, a roundworm, a starfish, a mussel, annelids, the crayfish, grasshopper and frog, and treats them in a very elementary way, supplemented by observation of the living animal. The only figure in the book is that of a microscope. Since the student must be taught not only to observe and to dissect, but also to sketch what he sees, a few sample drawings, fully labelled, would be helpful. The book is clearly printed and well bound.

Messer's "Introduction to Vertebrate Anatomy" and Atwood's "Concise Comparative Anatomy" adopt the 'systemic method'. This has the advantage of evolutionary sequence, but the disadvantage that the animal is not appreciated as a whole, and such a method ***does*** require the study of a single animal to give it balance. The authors have recognized this by adding, for further study, a list of books, many of which are monographs. The preparation of a second edition tempts an author to add new figures, and unless he is careful, the correlation of these with the text and with one another will be neglected. To take an example, Messer figures the arteries and veins of various vertebrates. In the dogfish the arteries are black and the veins white, in *Necturus* and the turtle both are white, in the bird both are striped, and in the mammal they are white. Why could not they be represented similarly in the different classes? Most of the diagrams, however, are clear and well printed; but the blocks of animals in the classification scheme are very much worn. No magnification is given, so that the field mouse appears to be larger than the jack rabbit, and the coney than the dugong. Each chapter ends with a summary, and there is a good glossary. Atwood's book has many diagrams of exceptional merit, but suffers from the same lack of correlation. The English portion of the text is satisfactory; but the Latin terminology is full of errors, for example, corpus restiformus, saccus vasculosis, corpora quadrigemini, and cæcums and appendices!

Potter's general "Textbook of Zoology" was written for rather more advanced students, but is not detailed enough for a British general degree course, although it contains an account of all the phyla. Of the forty-six chapters, eighteen were contributed by collaborators. The types method is used, and the various organs are printed in heavy type so that the paragraphs dealing with them can be easily found. The whole animal kingdom takes up about two-thirds of the book (650 pages) and the remainder has chapters of general interest, such as abnormalities, the endocrine glands, ecology, parasitism, marine zoology, wild-life conservation, genetics and eugenics, embryology, phylogeny and the theory of evolution. A glossary and an exhaustive bibliography are added. The book is thus both informative and interesting, and the author has attempted a compromise between a comprehensive study of the animal kingdom for the student who will proceed no further with the subject, and the necessity for providing the more enterprising and advanced student with the means of extending his knowledge, while stressing for both groups the importance of work in the field and in the laboratory. On the whole, these aims are fulfilled very well. Underlying it the author has in mind the understanding of scientific principles and training in scientific method.

Collaboration has resulted in a lack of uniformity in the standard of the work and in the figures. The section on the frog is unnecessarily elementary, following the more advanced chapters on the vertebrate

animal and the two chapters on fishes. In general the line blocks are good, the half-tone blocks so poor that they are sometimes unrecognizable, for example, the bull frog (Fig. 272), Linnæus (Fig. 12), and *Perophora* (Fig. 407). The text has been brought up to date, especially as regards recent work on hormones and vitamins; but here and there a statement causes a shock to the reader, such as this from the chapter on *Amphioxus*: "Ciliated nephridia similar to those of the earthworm lead from the dorsal portion of the coelom to the atrial cavity".

The production is pleasing, and the price (25*s.*) is not exorbitant.

N. B. EALES

EARTH HISTORY

The Formation of the Continents by Convection

By G. F. S. Hills. Pp. vi + 102. (London: Edward Arnold and Co., 1947.) 7*s.* 6*d.* net.

THE discontinuous sialic continents floating in the continuous simatic layer and the folded belts of the crust present two of the grandest problems of geology. In this essay, the solutions advanced are these. First, in the early liquid stage of the earth, crystallization began with the sinking of heavy olivine and the floating of light felspar; these floating crystals were carried by convection to the poles to form clumps which, as the liquid magma became more viscous and convection ceased, were then moved to the equator by the Eötvös force. During these operations, radioactive substances, concentrated in the felspathic material, heated the underlying olivine-layer which, thus expanded, elevated this material above the oceans to make the Laurasia and Gondwanaland of the palæogeographer.

The second problem is solved as a consequence of this expansion; the continental masses, pegged down to the Pacific rim, are domed up by uprise of basaltic material which, finding its own level, escapes around the rim, creasing up the continental and geosynclinal margins into the fold belts and, spreading over the floor of the present Pacific, carries with it fragments of continental material that formed, for example, New Guinea, Fiji and other islands. This gigantic basalt flow was responsible for the Cenomanian Transgression and a variety of other events.

With these two mechanisms in mind, the author discusses the Atlantic rift, the roots of mountains, the origins of fiords, the cause of the Quaternary glaciation, the salt in the sea and the absence of fossils in the Pre-Cambrian rocks, and finds many of the hard problems connected with these diverse topics more amenable.

Inquiries such as these into the mechanisms of the earth are naturally of interest to the geologist, who is usually not qualified to make them—he leaves it to the mathematician or geophysicist. The author views a great many geological operations in a different way from the geologist. His conception of the crystallization of magma, the formation of granite, the production of gneissose texture, the history of the fold-belts—to name a few special points—and his general use of the geological time-scale, are not those of the geologist dealing with the detailed anatomy of the crust. But still the author's proposals must be considered alongside those of Daly and Sir George Darwin, when the geologist comes to contemplate the bearing of his mass of detail on the grand problems of earth-history.

H. H. READ

FRUIT GROWING AND STORAGE

Harvesting and Storing Garden Fruit

By Raymond Bush. Pp. 162+16 plates. (London: Faber and Faber, Ltd., 1947.) 12*s.* 6*d.* net.

WHEN Mr. Raymond Bush sits down to write a book or an article, one may be sure that the result will be well worth the gardener's reading. There is always much wisdom, not untinged by humour, much of a life-time's accumulated experience and, usually, something at least to make one doubt or even disagree. His new book is no exception; no fruit-grower could read it without enjoyment and without learning a great deal; but some at least would feel a sense of disappointment. The book was obviously intended originally for the amateur fruit-grower—its title alone leaves no doubt on that point; but the author's enthusiasm for his subject carries him outside his field, and some of his suggestions would be beyond the means or the needs of all but the wealthiest of amateurs. The suggestion, for example, that quick-freezing of fruits and vegetables could be practised in the home is surely misleading, to say the least, when one considers that for satisfactory preservation an initial temperature of about − 30° F. is necessary. On this subject, details of the method of processing seem of little value or interest to the public for whom the book is intended, while for anyone seriously considering factory-production the information would be hopelessly meagre.

Taken by and large, it is a curiously compounded volume; one is left with the feeling that the author set out to write a book specifically to the title, and then, having found that it was of insufficient size, added five chapters at the beginning containing random dissertations on soils and climates for fruit-growing, manuring, pollination and other cultivational problems, all full of good advice and wise comment but having little direct bearing on the real subject.

On the central matter of storage, one cannot again help but feel a sense of disappointment. The storage of fruits has been a matter of such intensive scientific research, research which is not so difficult to 'put over' to the layman, that some attempt might be made to explain the physiological principles involved. The meaning and significance of the 'climacteric' in fruit ripening and storage is surely worth more than two paragraphs of explanation. Again, if the description of the quick-freezing process was worth inclusion, something might have been said of gas-storage, even if only to make the layman aware of the possibilities and limitations of the process.

At the end, the author again adds four chapters, which one would not expect from the title, on jam-making, bottling and canning, wines and fruit-juices. Here, at least, is a field in which the amateur can practise, and if the book stimulates a revival of the old art of home cider-making it will, on that alone, achieve much. The descriptions of home-made fruit wines fill one with the desire to start without delay on one's own 'brewery'; but further reading discloses the need for impossible quantities of that rare commodity, sugar, and regretfully one abandons hope until more spacious times come back.

Despite the criticisms which have been made, the book, as has been said, is one which all interested in fruit-growing can read with profit and enjoyment.

R. H. STOUGHTON

ELECTRONIC APPLICATIONS OF GERMANIUM

CRYSTAL rectifiers, the essential constituents of which are a metal and semiconductor in contact, are of two types, large-area contact rectifiers, such as copper oxide or selenium rectifiers, and point-contact ones, such as the germanium or silicon type. In both types the semi-conductor, which contains certain impurities, is in the form of a slab making contact on both top and bottom with the metal. For large-area contact rectifiers, rectification is obtained by making the intrinsic rectifications of the two metal-semiconductor contacts of different values, and for the point-contact rectifiers by making the area of one contact, usually the upper one and consisting of a small point at the end of a wire of metal such as tungsten ('cat's whisker'), very much smaller than the area of the other contact, the base electrode.

Germanium High Back-voltage Rectifiers

With the extension of radio communication to ultra-high frequencies, the use of point-contact crystal rectifiers in telecommunication circuits has become an established practice. The silicon rectifier, which is most suitable for ultra-high frequencies, is limited in that it can withstand only a small inverse voltage. The germanium crystal rectifier, in a form which has recently been developed[1,2,3], is less liable to overload. It can withstand a peak inverse voltage of 80 volts and deliver a maximum continuous current of 50 milliamperes; and although its frequency response is inferior to that of silicon, it is greatly superior to that of the metal-oxide rectifier. Its small weight and size ($\frac{1}{4}$ inch diameter and $\frac{3}{4}$ inch long) makes it particularly useful as a component in portable or miniature electrical equipment. As a detector or rectifier it can replace the vacuum diode, with the considerable advantage that, being a non-heating device, A.C. hum, noise, and thermal delay, from which all hot-cathode devices of the vacuum type suffer, are absent.

The germanium crystals used in these high back-voltage crystal rectifiers are excess (*n*-type) semiconductors, and are obtained from ingots formed *in vacuo* and slowly cooled. They require to be lapped in order to introduce large flow forces, which probably change the surface layers, and to be etched, the action of which is not clearly understood but which is said to improve the back voltage.

The Transistor

It is with germanium prepared in this fashion that J. Bardeen and W. H. Brattain, of the Bell Telephone Laboratories, in the course of a general investigation, initiated and directed by W. H. Shockley, on the properties of semiconductors, have developed a new three-element electronic device, called by them a 'transistor' (transfer-resistor) or 'semi-conductor triode'. This can be employed as an amplifier or oscillator and can replace the vacuum triode in most electronic circuits. The device, which consists of a metal cylinder, about an inch long and of the thickness of a pencil, containing the germanium and its three electrodes, was demonstrated with great success recently at a Press conference in New York. The transistor was used to amplify telephone and television signals, and a standard-model radio receiver, with transistors in place of the ordinary radio valves, operated quite satisfactorily. A standard frequency note generated by an oscillatory circuit employing transistors was also produced.

The construction and basic principles of operation of the transistor have been described by its discoverers in two letters communicated by them to the *Physical Review*[4]. In place of the single 'cat's whisker' of the crystal rectifier, two fine wires (both tungsten and phosphor-bronze have been used) make contact with the upper surface of the germanium block. These electrodes, the emitter and collector, are about 0·005–0·025 cm. apart. The third electrode, which is a large-area low-resistance contact, makes contact with the base of the block. Both the emitter and collector, when connected separately with the base, have characteristics similar to that of the high back-voltage rectifier. With a suitable positive bias on the emitter and negative bias on the collector relative to the base electrode, a signal introduced between the emitter and the base appears in amplified form between the collector and the base. Amplifications up to 100 times, that is to say, a gain of 20 decibels, have been obtained.

The transistor uses less power than a vacuum tube, has an output of 25 milliwatts and can operate at frequencies up to 10 megacycles per second. The collector has a high impedance and can therefore be matched to a high-impedance load. Being an excess (*n*-type) semiconductor, the main body of the germanium conducts electricity by excess electrons; but, as tests described in the second of two letters confirm, there is a thin layer next to the upper surface of the germanium which is of defect (*p*-type) positive-hole conductivity. Thus a current of positive-holes flows from the emitter and spreads over the surface of the semiconductor. Since the sign of the collector bias is such as to attract the positive-holes, a large part of the emitter current flows to and enters the collector. The collector has a high impedance for the flow of electrons into the semiconductor, but little or no impedance to the flow of positive-holes, so that for a signal voltage which varies the emitter current, there is a corresponding larger variation in collector current, producing the observed amplification.

The nature of the excess conductivity of the surface layer was investigated by means of probe measurements of the potential in the vicinity of a point contact on the plane surface of a thick block of germanium. Various surface treatments, in addition to the etch usually employed for crystal rectifiers, were used in different tests. The existence of the (*p*-type) conducting layer at the surface was confirmed, but the conditions very close to the point contact (within 0·01 cm.) were found to be complicated.

The transistor is not yet in production, but its simplicity, small size, performance, long life, and probably low cost when mass-produced, should find many applications in all forms of electronic equipment.

Non-rectifying Germanium

Following closely on the announcement of the transistor with its (*p*-type) defect surface layer, W. E. Dunlap and E. F. Hennelly, of the General Electric Company research laboratories, New York, report[5] the preparation of germanium of rather unique properties, of which the most striking is the almost

complete absence of surface rectification at the germanium–metal contact. The germanium ingots were prepared by melting germanium powder under a pressure of less than 10^{-4} mm. of mercury, and ten-point, plane-welded contact rectifiers were made from one ingot. The units were weakly (*n*-type) excess semiconductors at room temperature, where their average rectification ratio for 20 volts was 3·54, and (*p*-type) defect semi-conductors at −196° C., where the corresponding ratio was 1·22. For small voltages the rectification was negligible at both 25° and −196° C.; but for 20–100 volts the rectification factor increased to the order of 2. This is attributed not to a true rectification but to possible heating and consequent inhomogeneity in the germanium. Hall-effect measurements showed that the transition from *n* to *p* takes place at 70° C. The room-temperature resistivity, 17·8 ohm. cm., was increased by some 20 per cent by the application of a magnetic field of several thousand gauss, and the Hall coefficient, 514,000 E.M.U., decreased by about 30 per cent for an increase of field of approximately 10,000 gauss. The high magneto-resistance and variation of Hall coefficient with magnetic field, in spite of the apparently high degree of homogeneity of the germanium, is the second point of interest. It is suggested that these effects are intrinsic or else the inhomogeneity is on a scale small compared with the dimensions, about 0·0002 inch, of the point contact, and further work is in progress to test these ideas.

[1] *G.E.C. Rev.*, **51**, 13 (1948).
[2] *J. Sci. Instr. and Phys. Ind.*, **25**, 247 (1948).
[3] *Electronic Eng.* **20**, 232 (1948).
[4] *Phys. Rev.*, **74**, 230, 231 (1948).
[5] *Phys. Rev.*, **74**, 976 (1948).

NEW LIGHT ON THE ORIGIN OF MONEY

By Dr. PAUL EINZIG

MATERIAL produced by recent ethnological research calls for a revision of the hitherto generally accepted 'classical' conception of the origin and early evolution of money. That conception may be briefly summarized as follows: Barter developed as and when original communism (tribal ownership of the means of production) gave way to private property, and self-sufficiency of economic units gave way to division of labour. Money developed after the progress of division of labour and the growing complexity of the economic system had reduced barter to absurdity. The primitive forms of money originally adopted were gradually replaced by more advanced forms. Eventually, the functioning of advanced money economy led to the development of credit economy.

This conception is all but universally endorsed by economists, and is expressed briefly and superficially in most text-books on money. Yet in the light of ethnological and historical research it must be denounced as fundamentally false. Paradoxical as it may seem, it is nevertheless a fact that barter existed before the development of division of labour and private property in the generally accepted sense of these terms; that money originated long before the complexities of progressing economies had reduced barter to absurdity; that the origin of money was due to a large extent to non-commercial factors; and that credit existed already before money came into being.

According to the classical conception of economic history, foreign trade existed before home trade; barter first developed between tribes specializing in different cultures, while within the tribes themselves it only developed after the adoption of a certain degree of division of labour. This conception is entirely erroneous. There was ample scope for barter within a pastoral, agricultural, hunting or fishing tribe. As has been ascertained, members or households of a tribe specializing in one single culture are, in fact, in the habit of exchanging systematically their products against each other. For one thing, even though the entire tribe may be pastoral, that does not necessarily mean that they breed the same kinds of animals. Even if they do, there is, in any event, ample scope for exchanging young animals against old ones, good quality stock against inferior stock, etc. Likewise in an agricultural community there is ample scope for exchanging various agricultural products against each other.

There is ethnological evidence also for the existence of barter in communities where means of production constitute tribal property. Once the proceeds of production are distributed they become private property, and there may be occasion for bartering the products against each other. When the chief of a warrior tribe distributed among the tribesmen the proceeds of a successful raid or the tribute paid by subject tribes, the objects thus distributed became the private property of the recipients and provided occasion for barter among each other long before the development of private ownership of the means of production. In particular the enslaved captives provided material for systematic barter.

The conception that money came to be adopted as and when progress of division of labour had made it intolerably inconvenient to trade by means of barter is regarded as axiomatic by the overwhelming majority of economists. Yet there is ample ethnological evidence to prove that in a large number of communities barter continued long after the adoption of some form of standardized means of payment for non-commercial purposes. In many primitive communities in the Pacific area or Africa, internal trade is, or was until quite recently, conducted almost entirely by means of barter even though standardized means of payment were in use for certain non-commercial purposes, such as payment of bride price, contributions to religious sacrifices, subscriptions to secret societies, payment of tribute, ransom, blood money, etc. While it is known to ethnologists, it is not realized by the overwhelming majority of economists that, in primitive communities, such non-commercial payments are incomparably more important than commercial transactions proper. They wrongly believe that a community at an early stage of its economic evolution does not feel the necessity for the adoption of money unless and until barter has become too inconvenient owing to the growing variety of goods and services to be exchanged against each other.

In reality, barter is not nearly so inconvenient a system in a primitive community as is assumed by economists who look upon it through modern eyes. The instances quoted by economists to illustrate the difficulties that were eventually supposed to have led to the adoption of money are usually taken not from

the internal life of primitive tribes but from the experience of European travellers in dealing with them. There was the much-quoted experience of Cameron who, in order to be able to acquire an urgently needed boat in Tanganyika, had to exchange his brass wire against cloth, then cloth against ivory and finally ivory against the boat. There was also the well-known experience in Indonesia of Wallace, who had to do without dinner whenever vendors of food did not happen to want his goods. Mademoiselle Zélie, of the Théâtre Lyrique, Paris, complained in a much-quoted letter that her fee for a concert on one of the Society Islands, consisting of three pigs, twenty-three turkeys, forty-four chickens, five thousand coconuts and considerable quantities of bananas, lemons and oranges, was of little use to her. All these and many other instances may appear to the modern reader as a convincing proof that barter is an impossible system. Yet these instances only illustrate the difficulties and anomalies that are apt to arise through contact between two different civilizations. The natives of the communities visited by Cameron, Wallace and Mademoiselle Zélie were quite capable of making their own arrangements to ensure the smooth working of a system which, though far from ideal, suited their primitive requirements tolerably well. The fact that even culturally advanced communities with relatively developed economies, such as Ancient India and Ancient Egypt, conducted their trade mostly by barter shows that the inconveniences of that system have been grossly exaggerated by modern writers.

The development of some form of standardized means of payment must have preceded in most communities the achievement of a stage in the progress of division of labour when barter became impracticable. Long before that stage was reached, there already existed some form of money used regularly for non-commercial purposes. Nevertheless, the communities concerned continued to barter, not because they knew no better, but because they preferred to exchange goods and services against each other rather than against money. It was largely because the non-commercial purposes for which money was employed ensured a steady demand for the monetary objects that they gradually became favourite media of barter and ended by becoming media of exchange. It seems reasonable to assume, therefore, that money first developed to serve matrimonial, political or religious payments and was only later adopted gradually for commercial purposes. Possibly it was adopted as commercial means of payment even before division of labour made barter impossible.

Long before this stage was reached, an advanced credit economy developed in many primitive communities. During recent years ethnologists have described many communities in which trade was transacted mostly by barter, but which possessed, nevertheless, a highly involved credit system arising from the non-commercial use of some standardized means of payment. Thus in the New Hebrides there is a most elaborate and extensive credit system in terms of pigs, arising from the sacrificial use of the animals[1]. Shell strings required for subscriptions in secret societies formed the basis of a veritable inverted pyramid of credit system on the Banks Islands[2]. Payments in connexion with marriages resulted in a highly involved system of indebtedness in dogs' teeth currency among the Manus of the Admiralty Islands[3]. On Alor, in Indonesia, everybody is both a creditor and a debtor in a complicated system of reciprocal indebtedness in terms of bronze drums and gongs which form an indispensable part of the bride price[4].

The existence of a highly developed credit system in Babylonia many centuries before the adoption of coinage, during a period when the currency consisted of barley and uncoined silver, is an instance of the evolution of credit prior to the evolution of modern money.

Barter, by its nature, gave rise to a credit system before the adoption of money. This was not realized by some economists, who, however distinguished in their own lines, were unacquainted with the elements of anthropology. John Stuart Mill's picture of the tailor on the verge of starvation trying frantically to find a baker who happened to be in need of a jacket, in order to secure his daily bread in exchange for it, is a characteristic instance in this respect[5]. Fortunately for themselves and for the progress of mankind, primitive man had enough common sense to overcome the difficulty, which existed in Mill's imagination, that the tailor would not want as much bread at a time as would be worth the coat and that the coat could not be divided. In fact, the tailor could easily make arrangements with the baker to secure the supply of bread over a period in return for the sale of the coat. This is what is done regularly in present-day primitive communities. According to ethnological evidence, blacksmiths and other artisans are paid after harvest for goods and services supplied between harvests.

To some extent the development of primitive money actually does away with the necessity for credit system that was indispensable in a barter economy owing to the discrepancies between the value of the objects exchanged and the time-lag between their delivery. Thanks to the adoption of some object for monetary use, blacksmiths can now collect payment immediately instead of having to wait until the next harvest; and John Stuart Mill's imaginary tailor would have been able to sell his coat to the baker against cash payment instead of granting credit in terms of loaves.

Many of the above facts and conclusions may appear elementary to ethnologists. They are ignored, however, by the overwhelming majority of economists. It is of the utmost importance to establish closer co-operation between the two branches of learning for the benefit of both. It is to the interest of monetary economists to study more closely the origin and early phases in the evolution of money, instead of accepting as axiomatic the vague and out-of-date observations on the subject in Adam Smith's "Wealth of Nations". They have to become acquainted with the material produced by ethnologists. The latter, in turn, are in need of better acquaintance with the theoretical rules of monetary economics. In the absence of such knowledge, they are unable to make adequate use of their opportunities to study on the spot such primitive monetary systems as still exist. Their findings are apt to be exasperatingly vague. While asserting in general terms that certain material serves as the currency of a certain community, they very often fail to state precisely which monetary functions the material in question performs and to what extent. Above all, they are not qualified to ascertain if, and to what extent, the behaviour of primitive money conforms to the accepted rules of monetary theory. As primitive monetary systems are disappearing fast, it is of the

utmost importance that ethnologists engaged in field-work should equip themselves with the necessary knowledge of monetary theory while there is still a possibility of investigating the functioning of the primitive monetary systems which have survived to our day.

[1] Layard, G., "Stone Men of Malekula" (London, 1937), pp. 252–3; Harrison, T., "Savage Civilization" (London, 1937), pp. 26–28.
[2] Codrington, R. H., "The Melanesians" (Oxford, 1881), p. 236.
[3] Mead, Margaret, "Growing Up in New Guinea" (London, 1931), p. 218; Fortune, R. F., "Manus' Religion and Ethnological Study of the Manus Natives of the Admiralty Islands" (Philadelphia, 1936), pp. 49–50.
[4] Du Bois, Cora, "The People of Alor" (Minneapolis, 1944), pp. 143–5.
[5] Mill, John Stuart, "Principles of Political Economy" (London, 1878), p. 4.

VITAMINS AND ANTI-VITAMINS

AN interesting discussion on "Anti-vitamins in Food", arranged by the Nutrition Society, took place on October 23 at the Royal Society of Arts. Sir Edward Mellanby, who might justly claim to be the originator of the modern concept of anti-vitamins, was chairman. In his introductory remarks he pointed out that the 'anti-vitamin' or 'toxamin' theory is now some twenty years old, although his early claims that cereals must contain substances which antagonize vitamin D had not been immediately accepted. Later work, however, in identifying phytic acid as an anti-calcifying factor, had placed the existence of anti-vitamins beyond dispute. Considerable progress is now being made towards an understanding of the general principles underlying the mode of action of the anti-vitamins, and both their significance as dietary factors and their potentialities as therapeutic agents are clearly recognized.

Natural and Artificial Anti-vitamins

Dr. L. J. Harris recalled that Eijkmann, who shared a Nobel Prize with the late Sir Frederick Gowland Hopkins for the discovery of vitamins, resorted to what amounted to an 'anti-vitamin' theory to explain the results of his experiments on avian polyneuritis. Since a diet of polished rice caused polyneuritis, while rice polishings cured this condition, he assumed that the rice contained a toxin and the polishings an antidote. Hopkins, on the other hand, proved the reality of 'deficiency diseases', in which injury is caused simply by the absence of a vitamin from the diet, and not by failure of the vitamin to neutralize a dietary toxin. While Hopkins' conclusions have proved substantially correct, it is now realized that the adequacy or inadequacy of a diet in regard to a particular vitamin may often be influenced by the other constituents of the diet. Since the requirement of the organism for vitamin B_1 has been found to be proportional to the carbohydrate intake, we may regard the starch present in Eijkmann's polished rice as being antagonistic to the vitamin B_1 present in the polishings. In this limited sense, therefore, it may be considered a toxic substance.

The important work of Mellanby on the rachitogenic properties of cereal products, however, indicated that some foods contain substances, other than their major components, which antagonize the action of vitamins. Another important advance resulted from the demonstration by Fildes and Woods that the sulphonamide drugs owe their bacteriostatic action to their biological competition with *p*-amino-benzoic acid, a compound with a similar chemical structure which has since been recognized as a vitamin. The sulphonamides may therefore be regarded as artificial anti-vitamins, and, on the same principle, analogues inhibiting the action of most of the other vitamins have now been synthesized. Although it was not intentionally chosen as an anti-vitamin, the familiar insecticide 'Gammexane', or hexa-chloro-benzene, presumably owes its activity to its competition with the vitamin inositol, the corresponding hexa-hydroxy compound.

In estimations of vitamins in foodstuffs by biological tests, the results obtained will depend not only on the amounts of vitamin present but also on the amounts of anti-vitamin, as well as on the presence of substances which assist the vitamin in its absorption and utilization, and many other factors. Chemical tests, on the other hand, tell us how much vitamin is present, without enlightening us as to its degree of availability to the animal. Since both chemical and biological methods give results which are perfectly correct, within the limitations recognized in each case, it is obviously essential that in quoting vitamin values for foodstuffs the method used should be clearly stated.

Anti-B-vitamins

The numerous B-vitamins in themselves present a very complicated picture, which is made even more complex when we extend our studies to the corresponding anti-vitamins. Many B-vitamins, moreover, are synthesized by the intestinal bacteria, in amounts which differ widely in different animals, with the result that anti-vitamins may either affect the organism directly or through the agency of the intestinal flora. Altogether, Dr. E. Kodicek has enumerated five ways in which the action of B-vitamins may be inhibited, including (1) failure of intestinal absorption, (2) the destruction or inactivation of the vitamin by toxic substances or bacteria, (3) the inhibition of bacteria producing the vitamin by antagonists or the absence of an essential metabolite, (4) the displacement of the vitamin from the tissues by analogues, and (5) exposure of the organism to special stresses, such as infections, pregnancy, and a bad balance of the major components of the diet.

Various types of 'toxamins' may oppose the action of B-vitamins, but the term 'anti-vitamin' is perhaps best reserved for the structural analogues, which have already been synthesized in relation to aneurin, nicotinic amide, riboflavin, vitamin B_6, pteroyl glutamic acid, pantothenic acid, biotin, choline and inositol. Several natural toxamins have also been reported, including the thiaminase in live yeast which destroys vitamin B_1, a factor in maize which antagonizes nicotinic amide, the avidin of raw egg white which inactivates biotin, and the lycomarasmin of wilted tomato plants which antagonizes the bacterial growth-factor, streptogenin.

Rachitogenic and Hæmorrhagenic Toxamins

Phytic acid, a phosphorylated derivative of inositol, is the best known anti-calcifying agent in foodstuffs. Prof. R. A. McCance pointed out that evidence of the rachitogenic properties of cereal products was advanced by Mellanby in 1920; but it was not until about ten years later that Bruce and Callow found that phytic acid interferes with the absorption of calcium. Harrison and Mellanby then demonstrated that this substance had the same effect as cereals in causing rickets in dogs, while

McCance and his colleagues found in human feeding trials that the absorption of calcium was less efficient with wholemeal bread than with white bread as the main constituent of the diet. The addition of calcium to National flour was therefore undertaken in order to compensate for the increased amounts of phytic acid which resulted from the higher extraction-rate.

Unidentified rachitogenic agents have also been encountered in animal feeding-stuffs. Yeast is a valuable source of proteins and B-vitamins for pigs; but Dr. S. K. Kon and his colleagues have found that it causes rickets unless cod-liver oil, or some other source of vitamin D, is also given. Dr. T. K. Ewer has observed rickets in sheep reared in the southern island of New Zealand, where young green cereals are used as fodder. The condition responds to treatment with vitamin D; exposure to sunlight, however, is not effective, the tendency to rickets being greatest when good weather causes a rapid growth of the fodder.

Fatal hæmorrhages, associated with a prolonged blood-clotting time, have long been known to occur in cattle fed upon defectively cured sweet-clover, and Link and his colleagues identified the toxic agent as dicoumarin. Since full protection against the action of this substance may be secured by the administration of vitamin K, it may be regarded as a typical toxamin in the sense implied by Mellanby. Dr. P. Meunier, of Lyons, has studied the quantitative balance between hæmorrhagenic agents and vitamin K in the rabbit. Several synthetic analogues, including phenyl indanedione, have been found to cause increased clotting times, although they are generally less active than dicoumarin.

Imbalance of Fat-soluble Vitamins

Under this heading, Dr. T. Moore discussed the effects of toxic overdosing with one vitamin, and also the effects of deficiency or excess of various nutrients on the activity of the fat-soluble vitamins. Thus, massive overdosage with vitamin A leads in rats to skeletal fractures and hæmorrhages which are reminiscent of scurvy, while this disease has also been diagnosed in an American child given absurdly large doses of vitamin A. It has been reported that vitamin A deficiency causes a secondary deficiency of vitamin C in rats and silver foxes; but the significance of this vitamin in both deficiency and excess of vitamin A remains undecided. Hypervitaminosis A in rats, however, undoubtedly leads to a prolonged blood-clotting time which can be corrected by giving vitamin K.

The demands of the organism for carotene or vitamin A may be influenced by many factors. Extensive animal experiments have indicated that vitamin E, a powerful antioxidant, protects vitamin A from destruction in foodstuffs during storage, in the products of their partial digestion passing through the intestinal tract, and in the tissues of the consumer. In the human subject the habitual use of medicinal paraffin may seriously interfere with the absorption of carotene. Early work by Mellanby indicated that certain cereal products, and also ergot of rye, may emphasize the effect of vitamin A deficiency in causing nervous lesions, which his later work has associated with disordered growth of bone.

Massive overdosage with vitamin D causes excessive calcification, and doses approaching the toxic level have been found by Charpy and by Dowling to be valuable in the treatment of cutaneous tuberculosis.

Deficiency of vitamin E in experimental animals causes not only reproductive failure but also many other lesions including muscular dystrophy, brown pigmentation of the uterus and adipose tissues, exudative diathesis, encephalomalacia, renal abnormalities and dental depigmentation. Most of these lesions are increased in severity by an inadequate protein allowance, and by the inclusion in the diet of cod-liver oil or other highly unsaturated fats. Conversely, the lesions may be avoided or reduced in severity by removing fats from the diet, and by including adequate amounts of protein, choline, methionine and inositol. In general, therefore, liability to the effects of vitamin E deficiency is increased by the consumption of readily oxidizable fats, and decreased by adequate dietary supplies of the lipotropic factors which facilitate the mobilization and transference of fats.

Mr. A. L. Bacharach summarized the day's proceedings, and expressed his satisfaction in the success of the meeting in bringing together a mass of information on an interesting and important subject.

OBITUARY

Sir John Fryer, K.B.E., F.R.S.

Agricultural science has suffered a severe loss by the death on November 22 of Sir John Fryer, secretary of the Agricultural Research Council, at the age of sixty-two. The news came as a great shock to his many friends both in scientific and administrative circles.

John Claud Fortescue Fryer was born on August 13, 1886. His family had been farmers in Cambridgeshire and Huntingdonshire for generations, and his early years were spent at Chatteris in the fenlands; he was always happy to return to the East Anglian countryside. He was at school at Rugby and went on to Gonville and Caius College, Cambridge, where he took a first class in the Natural Sciences Tripos and a little later was elected a fellow of the College. He already had a good knowledge of British insects and, like his father and grandfather before him, was a keen collector and field naturalist. Some years abroad followed. He joined the Percy Sladen Expedition to Aldabra Island, in the Indian Ocean, and wrote a valuable account of the natural history of the island; he also spent some time in Ceylon where he worked on the genetics of the butterfly *Papilio polytes*. On returning to England, Fryer was appointed entomologist to the Ministry (then Board) of Agriculture, and devoted himself to the study of insects of economic importance in agriculture and horticulture. It was a new post and he started work in an office in Northumberland Avenue without laboratory accommodation or equipment. After a pioneering period, a small staff of entomologists and plant pathologists was recruited and the Ministry's Plant Pathology Laboratory established. Accommodation was found for a time at Kew, and in 1920 a move was made to permanent quarters at Harpenden, where Fryer made his home. As director of the Laboratory, he took a leading part in dealing with a great variety of problems and inquiries concerning insect and other pests of crops, in fostering and initiating research on control measures, and in establishing an efficient advisory service in these subjects throughout Great Britain. One of his major problems was the continually increasing threat of the

introduction into Britain of the Colorado beetle after its establishment on the Continent of Europe.

In 1941, the Ministry formed the Agricultural Improvement Council to act as a bridge between science and practice in agriculture, and Fryer became its first secretary. His work for some years had involved close contacts with the Agricultural Research Council, and in 1944, following the death of Dr. W. W. C. Topley, he accepted appointment as secretary of the Council. It was with some misgiving that he undertook this onerous task, for it meant continuous office-work in London, and he knew that there would be little or no time for his entomological interests.

In addition to his scientific attainments, Fryer possessed high administrative ability, and his appointment was quickly justified. His practical knowledge of farming, acquired in his early days, combined with a long experience of the application of scientific method in agriculture, admirably fitted him for the work. Moreover, he had, to a rare degree, the capacity to see and state clearly and succinctly the essential points of any problem, and many who sought his advice could testify to his clear-sighted, logical and helpful discussion of their difficulties. He was especially good in committee, where his sure grasp of essentials and his tactful guidance often brought a rambling discussion to a point.

Fryer was a real countryman and naturalist and a keen fisherman. He was at his best on a collecting expedition in some remote part of the country, and the briefest holiday was spent, if possible, where he could search for specially interesting or rare insects. He had fine collections of British Lepidoptera, Coleoptera and Hemiptera–Heteroptera and was an expert on the Microlepidoptera. He took great interest in the conservation of the British fauna and flora and was an active member of the Society for the Promotion of Nature Reserves and of various committees of the National Trust. He served as president of the Association of Applied Biologists and of the Royal Entomological Society; he was elected a fellow of the Royal Society in 1948. His official services were recognized by a knighthood in 1946.

In 1919, he married Constance Joan Denny-Cooke, of Bergh Apton, near Norwich, who, with a son and daughter, survives him. He was buried at Bergh Apton.

C. T. Gimingham

NEWS and VIEWS

The National Physical Laboratory, Light Division: Mr. T. Smith, F.R.S.

On his retirement last July, Mr. T. Smith completed a period of forty-one years service at the National Physical Laboratory, where he was in charge first of the Optics Section of the Physics Department and later of the newly created Light Division. The long series of investigations on geometrical optics which have established Mr. Smith as a leading authority in the subject were begun a few years after he entered the Laboratory with a paper to the Optical Society entitled "Practical Optical Calculations". This was the key for much of his later work. His outstanding contributions have been to the theory of algebraic, as distinct from trigonometric, methods of optical design, and in the development of methods of computation based on the use of calculating machines. A feature of many of his later papers has been the masterly application of matrix methods to optical problems. As is so often the case when alternatives to old-established procedures are offered, the adoption of Mr. Smith's design methods in the industry has been slow; but there are now signs that their value is being appreciated. Mr. Smith's work was recognized by his election to the Royal Society in 1932, and he has held the office of president both of the earlier Optical Society and the Physical Society. The younger workers in his subject recall with appreciation the care he always took that they should have the fullest opportunity to develop their views however unorthodox or immature. It is appropriate that the council of the Physical Society should have invited Mr. Smith to deliver the sixteenth Thomas Young Oration; this he has agreed to do in June 1949.

Dr. L. A. Sayce

Dr. L. A. Sayce, who has succeeded Mr. T. Smith as superintendent of the Light Division at the National Physical Laboratory, is fifty years of age. After serving in the Honourable Artillery Company in the First World War, he went to the University of Durham to study chemistry, taking honours in 1922, when he was awarded the Saville Shaw Medal. He remained at Durham carrying out research in inorganic chemistry, was awarded his Ph.D., and in 1927 was appointed University lecturer in chemistry. He remained at Durham until 1940, carrying out during this period considerable fundamental work in inorganic chemistry, instrument design, chemical kinetics and photography.

In 1940 Dr. Sayce joined the Ministry of Home Security to initiate a research group in connexion with camouflage, where he did excellent work until 1943. He was then transferred to the Ministry of Supply to take charge of alginate research. Unfortunately, he fell seriously ill soon after receiving this appointment and was away from active work for a year. On recovery he was appointed to the Scientific Research Department of the Admiralty as a principal experimental officer, and in this capacity he was responsible for considerable advances in the development of all kinds of instruments for laboratory use in the Admiralty experimental establishments. In particular he did excellent work in the applications of high-speed photography for laboratory purposes. On the re-organisation of the Admiralty Scientific Service in 1946, he was appointed assistant director of physical research. Dr. Sayce has earned a very high reputation in a wide field of science, and he brings to his new appointment a keen appreciation of the value of fundamental research and an exceptional ability to plan and supervise it.

Zoological Society of London: Mr. G. S. Cansdale

Mr. G. S. Cansdale has been appointed superintendent of the Zoological Society's Gardens in Regent's Park, London, in succession to Dr. G. M. Vevers, who retired on December 15 (see *Nature*, November 6, p. 727). Mr. Cansdale was educated at

St. Edmund's Hall, Oxford; he graduated in forestry and afterwards obtained a research degree for work on black poplars and their hybrids. He was appointed to the Colonial Forest Service in 1934 and served in the Gold Coast from then until 1948. During these years he took full advantage of the opportunities of studying the local fauna and made large collections of reptiles, birds and small mammals for the London Zoo, many of which were new to the collection; in addition, he made extensive collections for the British Museum (Natural History). He has published various popular articles dealing especially with small mammals and their ecology, and is the author of "Animals of West Africa", a general account of the more common mammals and reptiles of that region. In addition to being a keen naturalist, Mr. Cansdale has the advantage of practical experience in keeping live animals, for he and his wife maintained a private collection in Africa and were successful in the rearing and maintenance of a wide range of species, including some which are very difficult to adapt to a life in captivity, with the necessary dietary modifications involved. This experience will be of value in dealing with the many problems which arise in connexion with the maintenance of such a varied collection of animals as that in Regent's Park.

Physics To-day

THE avowed purpose of the American Institute of Physics is "the advancement and diffusion of physics and its applications to human welfare". For the research worker, the teacher, the theoretical or experimental physicist, and the investigator engaged in pure or applied science, the Institute or its member societies publish eight journals of very high merit. They are the well-known *Physical Review*, *Review of Modern Physics*, *Journal of the Optical Society of America*, *Journal of the Acoustical Society of America*, *American Journal of Physics*, *Review of Scientific Instruments*, *Journal of Chemical Physics* and the *Journal of Applied Physics*. To these, in order to fulfil an ever-growing demand for a medium for relatively non-technical surveys of physics progress, there has recently been added *Physics Today*. This new monthly magazine (published by the New York American Institute, May 1948; 50 cents) is described as "a general-interest journal on physics", and its editor is Dr. D. A. Katcher.

The first four numbers of *Physics Today* are very well produced and contain some excellent articles, besides regular features such as book reviews, Institute and Journal notes, and notes from abroad giving details of physics progress in Italy, Great Britain, Scandinavia and elsewhere. Of the articles, "A Newsman Looks at Physicists", by Stephen White, in the May issue is highly to be commended. It is packed with sound advice to the physicist who is called upon either to write for the general Press or to describe his work to some enterprising reporter. Of particular interest to British readers will be a brief but informative report in the May issue by D. L. MacAdam on the 1947 International Conference on Colour Vision held at Cambridge, England, and an illustrated account in the July issue, by the general secretary of the Royal Institution, T. Martin, of the Royal Institution Christmas Lectures. Other articles include: "Trends in American Science", by Vannevar Bush; "The Reality of Neutrinos", by Prof. G. Gamow; "Detecting Atomic Particles", by Prof. S. A. Korff; and "Helium, the Unruly Liquid", by Prof. L. Tisza. Perhaps the best way to summarize the scope and policy of the magazine, which assuredly has come to stay, is to quote from the editorial of the first number. "'Physics Today' is for the physicist, to inform him in comfortable, everyday language of what goes on and why and who goes where. But it is also for the chemist, the biologist, and the engineer, to tell them of the science towards which they are driven by so many of their investigations; it is for the student, the teacher, the lawyer, the doctor, and all who are curious about physics; it is for the administrative officials who deal with research; it is for editors and writers whose profession puts them midway between what is done and how it should be reported".

World Power Conference: 1950 Meeting in London

As already announced (see *Nature*, June 26, p. 1,005), the Fourth World Power Conference will be held in the building of the Institution of Civil Engineers, London, during July 10–15, 1950, and the theme of the Conference will be "World Energy Resources and the Production of Power". Sir Harold Hartley will be chairman of the Conference. The technical programme of the Conference has just been published, and copies may be obtained on application to the General Secretary, Fourth World Power Conference, 201–2 Grand Buildings, Trafalgar Square, London, W.C.2. It will be seen that the programme falls into three divisions. Division 1 will contain single reports, from each national committee, to include: (*a*) a survey of the energy resources of the country; (*b*) a historical record of the development of the resources of the country and of prime movers for utilizing them, covering the period since the First World Power Conference in 1924. Division 2 will consist of individual papers, dealing comprehensively with the preparation of fuel of every kind. Division 3, which is perhaps the most important, is headed "Production of Power". In addition to the traditional sources of power, papers will be included on gas turbines, jet engines, hot-air engines, tidal power, wind power, solar energy, terrestrial heat, thermal energy derived from the sea, and atomic energy. It is hoped that, despite the manifold difficulties surrounding the preparation of papers on atomic energy, some valuable contributions will be forthcoming. Although the technical programme does not contain a separate division on utilization, the hope is expressed that papers will be presented dealing with the design and relative advantages of different types of prime movers for specific purposes, for example, aviation, land transport and marine propulsion. Unesco has recently made a grant towards the statistical work carried out by the World Power Conference.

Arctic Ice

THE publication of the *Year-Book of the State of the Ice in the Arctic Sea* issued by the Danske Meteorologiske Institut, which was suspended in 1940, has been resumed on the traditional lines with charts for the spring and summer months. The Institute is trying to collect material for the years 1940–45 to make possible the publication of a report for that time. The present issue is for 1946. In that year the Barents Sea had rather less ice than usual. Details from the Kara Sea are lacking. Spitsbergen was open on the west for most of the summer, and in the north for longer than usual; but in the east, including Storfjord, there was continuous pack-ice until late in

August. In the Greenland Sea ice was less than usual, and parts of the coast of Greenland had periods of accessibility. Twice during May the East Greenland pack touched the north-west coast of Iceland. In Davis Strait the amount of ice was rather less than usual; but its late culmination was an unusual feature. There seems to be no data available for Bering Strait and the Beaufort Sea. In the North Atlantic there was an abnormally easterly distribution of icebergs; very few bergs followed the less important western branch of the Labrador current that flows along the Avalon Peninsula of Newfoundland. But the total amount of ice in the Newfoundland area was about the usual.

Fair Isle Bird Observatory

LYING directly between Orkney and Shetland, Fair Isle has been well known as a bird migration station since Dr. Eagle Clark began his observations there in 1905. Since the Second World War, and largely through the efforts of George Waterston, Ian Pitman and Arthur Duncan, the Fair Isle Bird Observatory Trust has been formed in order to develop the use of the island as one of Europe's premier bird observatories. Already a full-time director has been appointed and a certain amount of equipment installed; but much more support will be needed before the natural ornithological advantages of the island can be investigated. Copies of an attractive booklet describing the Fair Isle Bird Observatory can be obtained from 48 Castle Street, Edinburgh.

Kangaroos

THE ordinary person probably regards the kangaroo as the most characteristic of the native animals of Australia, and the Macropodidæ is the family with the largest number of species and contains the largest animals. Considerable work has been done on this group; but nevertheless the review of the family given by G. H. H. Tate (*Bull. Amer. Mus. Nat. Hist.*, **91**; 1948) is timely. The review falls into two parts, one on the anatomy and phylogeny, and the other on the taxonomy. It is suggested that phylogenetically two basal stocks, the subfamilies Potoroinæ and Macropodinæ, can be recognized; but the relationship between them is not clear. Some authorities have gone so far as to suggest that each has arisen independently from a phalangeroid stock. It seems clear that no division of the recent phalangerids could have given rise to either subfamily. Within the groups the author gives reasonable phylogenetic lines. To the four generally recognized subfamilies, the author adds a fifth for the reception of certain extinct species, the Palorchestinæ. He recognizes and defines 107 distinct forms falling into 22 genera. A considerable literature has grown up around the question of the specific identification of the kangaroo recorded by Captain Cook, and, after a review of this and other evidence, the author concludes that the animal in question is *Macropus canguru canguru*, a north-eastern subspecies, the south-eastern equivalent of which is *Macropus canguru major*.

Radar Training Devices

AT a meeting of the radio section of the Institution of Electrical Engineers on November 2, Mr. G. W. A. Dummer presented a paper entitled "Aids to Training —The Design of Radar Synthetic Training Devices for the R.A.F.". In this paper, the author describes how, during the War, work was conducted by the Trainer Design Group at the Telecommunications Research Establishment, in the development of equipment used by the Royal Air Force for training operators, navigators and controllers in radar techniques. With the introduction of each new radar system, a simple synthetic trainer was designed concurrently. As operational experience was gained on the equipment, a more complex crew trainer was developed; this provided accurate presentation of a moving synthetic target or targets, and complete operational practice with a record of the trainee's errors. Approximately seventy different types of trainers were developed for the various radar systems, varying in scope from the provision of simple synthetic echoes to a complex device such as the reproduction on the ground of a complete night-fighter interception in the air. The fundamental principles necessary for the control of synthetic targets in two and three dimensions are discussed in the paper, the presentation of which was illustrated by an extended cinematograph film. With the end of the War the urgent necessity for training devices declined, and comparatively few trainers are being designed at the present time. In the discussion at the meeting, however, various speakers pointed out the need of this type of equipment for training the crews and operators of civil aviation services.

Distance of Canopus

MR. O. R. WALKEY has investigated the distance of Canopus (α Carinæ) by a new line of approach (*J. Brit. Ast. Assoc.*, **58**, No. 6; 1948). The results obtained for this star vary considerably, some of the derived parallaxes being more than five times those of others. Mr. Walkey approaches the problem from the secular parallax of the star, a star's proper motion being frequently a fair criterion of its distance, and the radial velocity of Canopus provides a clue in the present case. Accepting results he has obtained for the apex of the solar motion (*Mon. Not. Roy. Ast. Soc.*, **106**, No. 4; 1946) and also for the velocity of the sun, the antapex of this motion, R.A. 90·2°, Dec. −28·7°, is just 24° north of Canopus, and as the recessional radial velocity of the star is 20·8 km./sec., we may regard it as stationary within the velocity framework. The proper motion of Canopus in R.A. is given as $0{\cdot}0020^s \pm 0{\cdot}0012^s$ in G.C., and the large probable error in R.A. should, Mr. Walkey thinks, warrant the simplicity of considering the motion in declination alone in the investigation. This is $0{\cdot}017'' + 0{\cdot}0015''$ towards the solar antapex, and applying the correction for galactic rotation it becomes $0{\cdot}0126'' \pm 0{\cdot}0015''$. If this represents the crosswise reflex of the sun's motion from the antapex, the absolute parallax of Canopus is $0{\cdot}0071'' \pm 0{\cdot}00009''$. Adopting a final parallax of $0{\cdot}007''$ or a distance of 450 light-years, the absolute magnitude of the star is −6·6. It is significant that this distance finds confirmation in Charlier's determination of the distance of the centre of the brighter *B*-type stars lying in Carina (*Medd. Lund.*, Series ii, **14**; 1916. **34**; 1926). The revised and higher luminosity basis, of one magnitude brighter than that used by Charlier for the given *B* stars, places their centre at a distance represented by a parallax of $0{\cdot}0072''$.

International Union of Biological Sciences

THE programme of symposia, organised with the help of Unesco by the International Union of Biological Sciences, started in November 1947 with a symposium on trace elements in plant physiology.

held at Rothamsted (see *Nature*, **161**, 364; 1948). The report of this Conference is in the press at Chronica Botanica Co., Waltham, Mass. The second symposium of this series was held during June 14–19, 1948, at Utrecht; it dealt with the theoretical basis of botanical nomenclature and systematics. The full report will also be published by the Chronica Botanica Co. A third symposium was the first International Congress on the Physio-Pathology of Animal Reproduction at Milan; it lasted two days (June 21–22, 1948) and its theme was: "Interactions between Eggs and Sperm". The full report is to be published by its secretary, Prof. T. Bonadonna, Via Fratelli Bronzetti 17, Milan. A symposium on Terminology of Cytogenetics and Genetics was held at Stockholm during July 15–16, 1948. This symposium carried further the work done at the pre-war symposium held in London during August 14–15, 1939. A committee has been formed to supervise the preparation of the full report, which probably will be published as a separate number of *Bibliographia Genetica*. Finally, a fifth symposium was held at Stockholm during August 5–7, 1948, which discussed the scientific foundations of an international organisation for combating agricultural pests. A programme for further work on the subject has been drawn up; and the report of the meeting will be published by the general secretary of the International Union, Prof. P. Vayssière, Muséum d'Histoire Naturelle, Paris.

City and Guilds of London Institute

THE report of the Council of the City and Guilds of London Institute for 1947 gives ample evidence of the Institute's growing activities. There has been a large increase in the number of students at the City and Guilds College, particularly postgraduate and research students. In the Department of Technology the total number of candidates examined was 47,807, 7,336 higher than the previous highest total of 40,471 recorded in 1939. Among the regulations and syllabuses for existing examinations which have been revised during 1947 are those of petroleum and petroleum products, electrical engineering practice, road service work and motor-vehicle electrician's work; while among syllabuses at present being considered for introduction later into the examinations conducted by the technology department are courses in works administration subjects for craftsmen, servicing and maintenance for instrument mechanics, and courses for electrical apprentices in iron and steel and other heavy engineering work. Copies of the report may be obtained from Gresham College, Basinghall Street, London, E.C.2.

Exhibition of Radiographs

AN exhibition of industrial radiographs will be held at the spring meeting of the Industrial Radiology Group at the Institute of Physics on February 18 and 19, 1949. Entries should be suitable for showing on standard viewing lanterns (mounted prints may also be submitted) and should, wherever possible, be accompanied by photographs or samples of the specimens which they represent. A short description should accompany each entry. Intending exhibitors should apply to the Institute of Physics, 47 Belgrave Square, London, S.W.1, for entry forms.

"Animals of Australia"

THE third of the series of natural history booklets has now been published by the Glasgow Art Galleries and Museum. Like the first two of the series, "Animals of Africa" and "Animals of India", the new booklet has been written primarily as an account of the Australian habitat group, one of the large groups in the Mammal Court of the Museum. The booklet contains a simple description of the life and habits of each of the animals as well as a photograph and outline drawing which serves as a key to the display.

Announcements

THE president of the Royal Society has appointed the following vice-presidents for the ensuing year: Sir Thomas Merton, treasurer of the Royal Society; Sir Edward Salisbury, biological secretary of the Royal Society, director of the Royal Botanic Gardens, Kew; Sir James Chadwick, master of Gonville and Caius College, Cambridge; Prof. A. C. Hardy, Linacre professor of zoology in the University of Oxford.

DR. H. GREINACHER, professor of experimental physics in the Faculty of Sciences of the University of Berne, has been awarded the Theodor Kocher Prize by the University in recognition of his skill in experimental work, specially for the development of the 'Greinacher circuit', widely used in applied X-rays. This circuit, which was described in 1914 (*Deutsch. Phys. Gesell. Verh.*, **16**, 320; April 15, 1914), is one of the best-known circuits that combine voltage-multiplying with a constant potential.

Dr. F. A. Burchardt, of Magdalen College, has been appointed director of the Oxford University Institute of Statistics, with effect from January 1, in succession to Mr. D. G. Champernowne, now professor of statistics in the University.

MR. A. W. HENDRY has been appointed to the University readership in civil engineering tenable at King's College, University of London, as from May 1, 1949. The title of professor of chemical pathology in the University has been conferred on Dr. Jocelyn Patterson, in respect of the post held by him at Charing Cross Hospital Medical School. The degree of D.Sc. has been conferred on Mr. E. R. Leonard, an internal student.

THE Langley Memorial Prize, offered by the London School of Hygiene and Tropical Medicine, and open to competition among officers, past and present, of the West African medical departments, has been awarded to Dr. D. Fitzgerald Moore for an essay entitled "Nutritional Eye Disease and Effects of Nutritional Retrobulbar Neuritis".

TRINITY COLLEGE, Cambridge, offers research studentships and Dominion and Colonial exhibitions every year; the next elections will take place in July 1949. Research studentships are open to graduates of universities other than Cambridge who are not more than twenty-six years of age, although in computing his age a candidate may deduct any period of war service. The exhibitions are open to undergraduates as well as those wishing to undertake research. Applications, to be sent through the head of the candidate's university, must reach the Senior Tutor, Trinity College, Cambridge, not later than May 1, 1949.

Two Christmas Lectures, for older children, will be delivered at the Institution of Electrical Engineers by Dr. P. Dunsheath, under the general title "Electricity: a Giant Harnessed". The Lectures will be given on December 29 and 30 at 3 p.m.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

X-Ray Line Broadening in Cold-worked Metals

It is known that X-ray line broadening in cold-worked metals appears to tend towards a limiting value as the amount of deformation increases. A possible cause of this might be self-annealing. If, as is very probable, line broadening is due mainly to internal strains, self-annealing would lead to strain release or recrystallization as soon as the internal strains reach a critical magnitude, which, of course, would depend on the temperature.

Since self-annealing must be insignificant at the temperature of liquid nitrogen, the limit to the line broadening ought to be very much higher or absent in metals cold-worked at this temperature if it is due to thermal recovery or recrystallization. In this case, moreover, the increased line breadth observed after deformation and subsequent X-ray exposure at a low temperature would fall to the room-temperature value after keeping the specimen at room temperature for the time needed for an X-ray exposure.

In order to test whether line broadening is influenced in this way by self-annealing, we have taken back-reflexion X-ray photographs from wire specimens plastically deformed in torsion. The progress of the broadening of the (311) line with deformation is shown in Fig. 1 for high-conductivity copper. The low-temperature results were obtained by deforming and exposing the specimens while liquid nitrogen was flowing over them. Further measurements after warming up to room temperature have shown that no appreciable recovery occurs within several weeks.

For commercially pure aluminium deformed at either temperature (Fig. 2), the line breadth decreases slowly on keeping the specimen at room temperature; however, the recovery of the line breadth is still incomplete after several weeks.

The absence of a significant decrease of the line breadth within the time needed for the deformation of the specimen and the subsequent X-ray exposure shows that the limit to the line broadening cannot be due to recovery or recrystallization. With metals that show rapid recovery of mechanical and other properties at room temperature, of course, recovery may limit the line breadth to lower values than would be attained in its absence. Thus, Hutchison[1] has recently found that the line broadening observed with high-purity aluminium deformed and exposed at the temperature of liquid air disappears when the specimen is brought to room temperature. This is in accord with the fact that high-purity aluminium is self-annealing and even recrystallizes rapidly at room temperature.

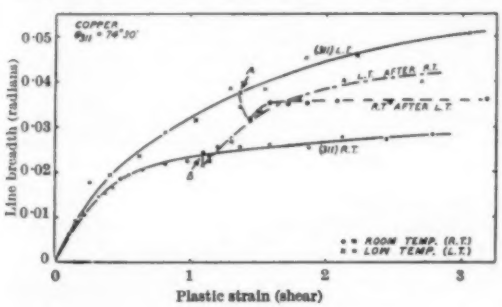


Fig. 1

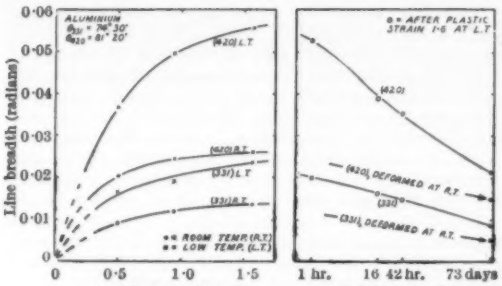


Fig. 2

Our observations support the view put forward by van Arkel and others[2,3] that line broadening, being due to internal stresses, is limited by the circumstance that the shear stress cannot rise beyond the yield stress of the material (which depends on the preceding plastic strain). Obviously, the hydrostatic component, and, therefore, the total value of the microscopic local stresses, cannot be of a higher order of magnitude than the local shear stresses. Figs. 1 and 2 show that, within the strain-range studied, the line breadth does not definitely converge towards a constant value; the line breadth curves merely become flatter with increasing strain, as yield stress-strain curves do.

It seems surprising that the stresses responsible for the line broadening are of the order of the macroscopic yield stress, whereas the 'theoretical shear strength' and the stresses around the dislocations must be of a higher order of magnitude. The answer seems to be that stresses of the order of the 'theoretical shear strength' never occur, except in the centre zone of dislocations; new dislocations arise from existing ones by some multiplication mechanism[4,5] (for example, by the glide process jumping from one glide plane to another). The dislocations, however, cannot contribute much to a Debye–Scherrer ring, for several reasons. First, the total volume of the highly stressed regions around the dislocations is small compared with the volume of the specimen; then, the range of strains around the dislocation is so large that the corresponding strain broadening extends over a very large angle; and, finally, there must exist an extreme small-size broadening, since the size of the coherently diffracting regions in a dislocation cannot amount to more than a few interatomic spacings. The high stresses around the dislocations, therefore, contribute mainly to the background in the X-ray photographs, while the line broadening is due to stresses of the order of the macroscopic yield stress. If other factors contributing to the background (impurities, thermal movement) can be eliminated, the density of the background may give a measure of the density of dislocations in the material.

Photo-elastic stress measurements in plastically deformed transparent crystals[6,7] also show that most of the volume (the glide packets) is not stressed beyond the macroscopic yield value; the volume occupied by the thin glide zones (between the glide packets), where the high stresses are concentrated, is very small.

The close connexion between line broadening and yield stress is shown by experiments in which the temperature was changed during the deformation. In Fig. 1, the broken curve resulted from deformation at room temperature, after the specimen had been strained up to point *A* in liquid nitrogen. After a small initial dip, the curve of the line breadth tends with increasing strain towards that for a specimen deformed entirely at room temperature. Similarly, the line-breadth curve of a specimen strained to the point *B* at room temperature, and from then on in liquid nitrogen, tends towards the curve for deformation in liquid nitrogen from the beginning. After a change of temperature, the line breadth tends towards the values characteristic of the new temperature, in general, only if additional deformation is carried out, but not spontaneously in the course of time (unless the material shows general effects of self-annealing). The same behaviour was observed by J. Los[8] for the yield stress of copper and aluminium deformed alternately at low, and at room, temperature.

M. S. Paterson
E. Orowan

Cavendish Laboratory,
Cambridge. Oct. 14.

[1] Hutchison, T. S., *Nature*, **162**, 374 (1948).
[2] van Arkel, A. E., *Physica*, **5**, 208 (1925).
[3] Megaw, H. D., and Stokes, A. R., *J. Inst. Metals*, **71**, 279 (1945).
[4] Orowan, E., *Z. Phys.*, **89**, 640 ff. (1934); Symposium on Internal Stresses, London, 1947, p. 53 (Inst. of Metals, 1948).
[5] Frank, F. C., Conference on Strength of Solids, Bristol, 1947, p. 48 (Phys. Soc., 1948).
[6] Obreimow, I. W., and Schubnikoff, L. W., *Z. Phys.*, **41**, 907 (1927).
[7] Nye, J. F., *Nature*, **161**, 367 (1948); and results to be published.
[8] See Orowan, E., *West of Scotland Iron and Steel Inst.*, 45 (Feb. 1947).

Recording of Charged Particles of Minimum Ionizing Power in Photographic Emulsions

Since the announcement of a photographic emulsion of sufficient sensitivity to record unmistakably the tracks of electrons[1], interest has centred on the possibility of achieving further increases in sensitivity, the recording of the complete tracks of *any* charged particle being the ultimate aim[2,3].

A singly charged particle, with a velocity of the order of 90 per cent of that of light, has the lowest ionizing power that a charged particle can possess. The energy of an electron, when it possesses this minimum ionizing power, is between 500 and 1,000 keV., and the residual path-length in the emulsion of such an electron will be between 800 and 2,000 μ, assuming a stopping power to electrons of 2,000 for the emulsion. The present commercially available electron-sensitive plates (Kodak *NT2a*) will record tracks of electrons with energies of up to 80 keV., the residual path-length[4], in the emulsion, of an electron of 80 keV. being about 30 μ. Since the ionizing power of such an electron is approximately three times that of the minimum, an emulsion with a threefold increase in sensitivity over that of *NT2a* is required in order that tracks of particles of minimum ionizing power should be recorded.

The experiments which are being made in these Laboratories already show that such substantial increases in speed over that of the *NT2a* emulsion are possible that we are encouraged to believe that sensitivity to minimum ionizing power can be attained. The accompanying photomicrographs were obtained from γ-ray experiments on 200-μ thick coatings of an experimental emulsion. They show tracks never before realized, and their great interest is regarded as sufficient to justify their description at this early stage in the evolution of such emulsions.

Fig. 1

Owing to the high scattering which electrons undergo in the photographic emulsion, particularly towards the end of their range, complete tracks ending in the emulsion, with a length of the order of 1,000 μ, will be very rare. A further difficulty in obtaining a complete recording in the emulsion of high-energy electron tracks is that the production of secondary electron tracks is very frequent, and, again due to the high scattering of electrons, the chance that all the secondary electron tracks will end in the emulsion is very small.

Thus, although a 1,000-μ track of an electron which comes to rest in the emulsion would be the more conclusive evidence that the minimum ionizing power could be recorded, such a track has not yet been

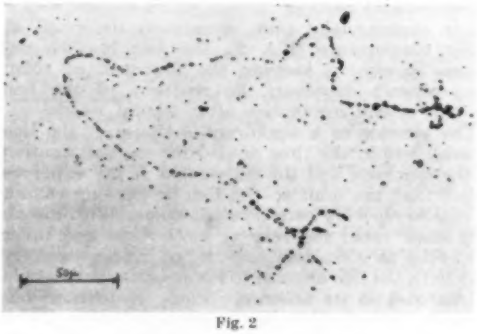


Fig. 2

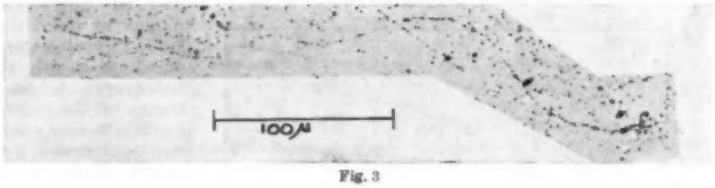


Fig. 3

Fig. 4

Fig. 5

found, and the accompanying selection of photomicrographs has therefore been chosen to demonstrate the sensitivity of this emulsion.

Fig. 1 is a photomicrograph of an electron track 240 μ long which ends in the emulsion, and was selected because no secondaries are formed and the scattering perpendicular to the emulsion plane is small. Fig. 2 is a photomicrograph of an electron track 350 μ long which has secondaries at the low-energy end, but otherwise is singularly free from such tracks. There is a confused bunch near the beginning of this track; but there is some doubt as to whether all these tracks are associated with that of 350 μ or not. The capability of the emulsion to record a complete electron track of 350 μ is, however, amply demonstrated. Fig. 3 is a photomicrograph of an electron track 400 μ long, which probably ends in the emulsion with the formation of at least one secondary, and which shows appreciable scattering throughout the whole of its recorded range. Fig. 4 is a photomicrograph of a track, very probably made by an electron, which is 830 μ in length, and shows some scattering throughout the whole of its recorded path. It does not end in the emulsion. Fig. 5 is a photomicrograph of a track which passes completely through the emulsion from one edge of the plate to the other. This track is perfectly straight, has a total length in the emulsion of 23,200 μ, and a constant grain-density throughout the whole of this length. Although the possibility cannot be ruled out that the particle producing this track was not an electron, such tracks have frequently been found in emulsions of this sensitivity after exposure to gamma rays, whereas the corresponding unexposed control has been free of them. In general, the tracks are shorter than those recorded here, as the chance that the particle makes such a small angle with the plane of the emulsion that it remains in the emulsion from one side of the plate to the other is very small; but similar tracks of 5,000 and 10,000 μ have been observed.

It is considered that these photomicrographs provide very strong evidence that an emulsion capable of recording the tracks of charged particles of any energy has been produced.

I wish to express my gratitude to Dr. D. T. King, of the H. H. Wills Physical Laboratory at Bristol, for selecting the tracks shown in Figs. 1, 2 and 5, and for helpful discussions on their interpretation; also to Miss P. Dyer of the same Laboratory for preparing the photomicrographs and mosaics for these figures, and to Mr. Cooke of the Kodak Laboratories for preparing the photomicrographs and mosaics for Figs. 3 and 4.

This letter is based on work carried out under contract to the Atomic Energy Research Establishment, Ministry of Supply, whose permission to publish is gratefully acknowledged.

R. W. Berriman

Kodak Research Laboratories,
Wealdstone, Harrow,
Middlesex. Nov. 15.

[1] Berriman, R. W., *Nature*, **161**, 432 (1948).
[2] Webb, J. H., *Phys. Rev.*, **74**, 511 (1948).
[3] Berriman, R. W., *Phot. J.* (in the press).
[4] Hers, R. H., *Nature*, **161**, 928 (1948).

Absorption and Dispersion of Ultrasonic Waves in Acetic Acid

In a recent communication, Pinkerton[1] has shown that for frequencies less than 70 Mc./sec. the absorption of ultrasonic waves in acetic acid can be attributed to a relaxation mechanism arising from the perturbation of a molecular equilibrium by the ultrasonic vibrations. His measurements were carried out in the frequency range 7·5–67 Mc./sec. and confirmed the earlier results by Bazulin[2].

Pinkerton concludes that, in accordance with the theoretical work of Kneser[3], the pressure absorption coefficient, α, for a frequency of excitation $f(=\omega/2\pi)$, can be described in terms of the relaxation time, τ $(=1/2\pi f_m)$, by the equation

$$\alpha/f^2 = \frac{\alpha_1}{f^2} + \frac{A}{1+\omega^2\tau^2} = \frac{\alpha_1}{f^2} + \frac{A}{1+(f/f_m)^2}, \quad (1)$$

where the component α_1/f^2 $(= 155 \times 10^{-17}$ sec.^{2} cm.$^{-1}$ for a temperature of 17·5° C.) represents the absorption due to viscosity, heat conduction, and any further possible relaxation process occurring above 100 Mc./sec. (Strictly, A can only be treated as a constant if the velocity dispersion is small, as is here the case (Fig. 3).) Equation (1) can be rewritten

$$(\alpha/f^2 - \alpha_1/f^2) = \frac{\alpha'}{f^2} = \frac{A}{1+(f/f_m)^2}, \quad (2)$$

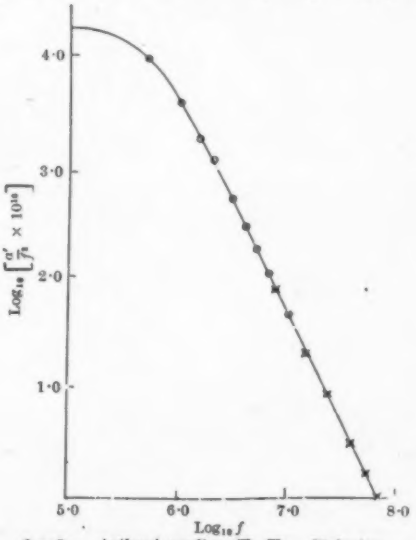
where α' represents the contribution to the absorption due to the relaxation mechanism under investigation. If v is the velocity of propagation, the quantity

$$\mu = \alpha'\lambda = \frac{Avf}{1+(f/f_m)^2} \quad (3)$$

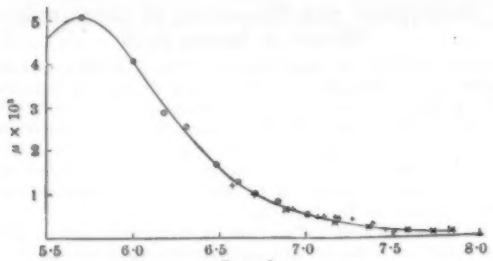
attains a maximum value at the frequency

$$f = f_m = \frac{1}{2\pi\tau}. \quad (4)$$

Pinkerton estimates that, for a temperature of 17·5° C., f_m should be around 2×10^6 c./s. This is, however, below the lowest frequency employed in

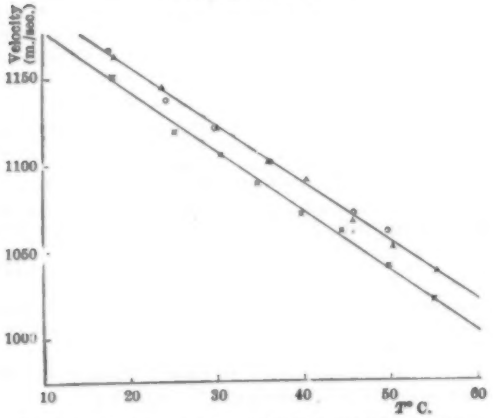


○—○—, Authors' results; □—□—, Pinkerton
Fig. 1. Absorption in acetic acid. Calculated curve for 17·5° C.



○—○—, Authors' results; □—□—, Pinkerton; +—+—, Bazulin

Fig. 2. Calculated curve showing the variation of $\mu = \alpha'\lambda$ with frequency at 17·5° C.



○—○—, 5 Mc./sec.; △—△—, 4 Mc./sec.; □—□—, 0·5 Mc./sec.

Fig. 3. Velocity dispersion in acetic acid

his experiments, and we have now extended the measurements to obtain values for the absorption in the frequency range 0·5–9·8 Mc./sec.

A pulse technique has been used[4,5,6] which enables the velocity of propagation to be measured[7] in addition to the absorption coefficient. From equations (2)* and (3)

$$\frac{1}{\alpha'} = \frac{1}{A}\left[\frac{1}{f^2} + \frac{1}{f_m{}^2}\right]. \qquad (5)$$

The value of A and a first estimate of f_m can therefore be derived from a plot of $1/\alpha'$ against $1/f^2$. A more reliable estimate of f_m can be calculated from the slope of the line obtained by plotting $\sqrt{A/\frac{\alpha'}{f^2} - 1}$ against frequency. The values are as follows:

T° C.	$\frac{a_1}{f_1^2} = \left[\frac{a}{f^2}\right]_{f \gg f_m}$ sec.² cm.⁻¹	$A = \left[\frac{\alpha'}{f^2}\right]_{f \ll f_m}$ sec.² cm.⁻¹	Frequency for maximum μ	
			1st estimate	2nd estimate
17·5	155×10^{-17}	$175{,}000 \times 10^{-17}$	$0{\cdot}500 \times 10^{6}$ c./s.	$0{\cdot}501(2) \times 10^{6}$ c./s.

The curves of Figs. 1 and 2 have been obtained by substituting these values in equations (2) and (3) respectively, and it will be seen that there is good agreement between the experimental points and the calculated curves.

Corresponding to the maximum in μ, a dispersion of the velocity has been recorded, as shown in Fig. 3. The values of the velocity above 4 Mc./sec. were all found to coincide with the upper line, whereas the lower line gives the results at the lowest frequency of measurement; the values for the intervening frequency-range lie between these two extremes. The maximum change in velocity to be expected from Kneser's theoretical calculations is given by

$$\frac{\Delta v}{v} \approx \frac{\mu_{max}}{\pi} \approx 1{\cdot}6 \text{ per cent at } 17{\cdot}5° \text{ C.}$$

The value obtained is slightly less than this, the discrepancy being attributed to the limited accuracy of the velocity measurement.

Spakowski[8] has previously reported a velocity dispersion in acetic acid; but his values are about 10 per cent greater than the present measurements indicate.

The temperature dependence of f_m and μ_{max} has been studied in conjunction with Pinkerton, and it is hoped to publish these results at a later date. We wish to thank Mr. Pinkerton for having provided his experimental values for inclusion in Figs. 1 and 2.

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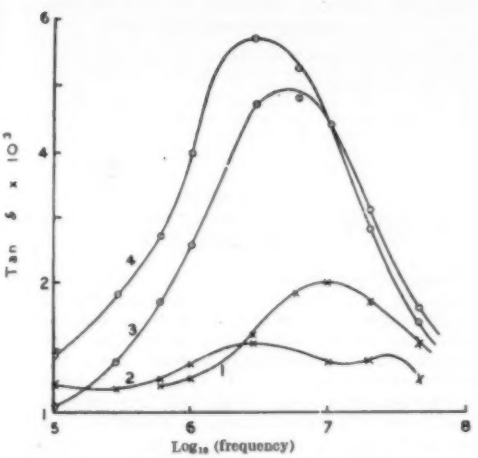
[1] Pinkerton, J. M. M., *Nature*, **162**, 106 (1948).
[2] Bazulin, P., *C.R. Acad. Sci., U.R.S.S.*, **3**, 285 (1936).
[3] Kneser, H. O., *Ann. Phys.*, **32**, 277 (1938).
[4] Pinkerton, J. M. M., *Nature*, **160**, 128 (1947).
[5] Pellam, J. R., and Galt, J. K., *J. Chem. Phys.*, **14**, 608 (1946).
[6] Rapuano, R. A., *Phys. Rev.*, **72**, 78 (1947).
[7] Ringo, G. R., Fitzgerald, J. W., and Hurdle, B. G., *Phys. Rev.*, **72** 87 (1947).
[8] Spakowski, B., *C.R. Acad. Sci., U.R.S.S.*, **18**, 169 (1938)

Dielectric Relaxation-Times of Solid Solutions of Aliphatic Long-Chain Esters and Ketones in Paraffin Wax and *n*-Hexacosane

IN the search for relationships between electrical properties and the chemical and physical structures of solid dielectrics, the experimental investigations by Jackson[1], Sillars[2] and Pelmore[3] are of considerable interest. These workers incorporated small quantities of aliphatic long-chain esters in paraffin wax and measured the dielectric loss (tan δ) of the resulting mixtures over a range of frequencies, the inverse of the angular frequency (ω) for the maximum tan δ giving the relaxation time (τ) of the ester molecules. This work was extended by Frõhlich[4] in a theoretical study of a model comprising a crystalline paraffin hydrocarbon in which a small proportion of the molecules was assumed to be replaced by molecules of a polar compound, such as a ketone or ester, of a shorter chain-length. The transition of the polar molecules from one position of the equilibrium to another having opposite dipole direction required the crossing of an energy barrier which increased in proportion to the chain-length. This led to an equation for the relationship between the relaxation time and chain-length, in which some of the constants were determined from the experimental results referred to above.

As paraffin wax is not a simple crystalline structure, it was thought desirable to conduct experiments using a pure hydrocarbon as the non-polar medium. An investigation is therefore being made in this laboratory of the relaxation times of various polar compounds in both paraffin wax and *n*-hexacosane



Dielectric loss curves for 0·1-m. solutions of: (1), decyl laurate in paraffin wax; (2), decyl laurate in *n*-hexacosane; (3), laurone in paraffin wax; (4), laurone in *n*-hexacosane

($C_{26}H_{54}$). The results for the ketone, laurone ($C_{23}H_{46}O$), and an ester of similar chain-length, decyl laurate ($C_{22}H_{44}O_2$), are shown graphically in the accompanying figure. The curve for decyl laurate in paraffin wax is of the type obtained by Jackson[1] and Sillars[2] with the ester, cetyl palmitate. The corresponding *n*-hexacosane system, however, gave an unsymmetrical curve showing no definite relaxation-times. This difference in dielectric behaviour is probably associated with the presence or absence of amorphous regions in the two solvents, since this is the chief difference in their physical structures. The paraffin wax – decyl laurate system would thus be a solution in which the molecules of the latter fit loosely into amorphous regions in the solvent, whereas the *n*-hexacosane mixture may not be a true solution but a eutectic consisting of *n*-hexacosane interspersed with aggregates of ester molecules.

In contrast to the esters, the ketone, laurone, gave a normal-shaped curve in *n*-hexacosane, and hence it is likely that this system is a true solid solution, of the type postulated by Fröhlich, in which the polar molecules enter the crystal structure by replacing hydrocarbon molecules. In the paraffin wax medium, also, the laurone molecules probably occupy crystalline positions, since the maximum frequency value is lower than for the ester of similar chain-length, indicating a higher energy-barrier between the two equilibrium positions of the molecules. The results discussed above were in agreement with the data obtained from measurements with other esters of the C_{22} series, and also with the ketone, myristone ($C_{27}H_{54}O$), and esters of similar chain-length.

From these results it seems that Fröhlich's model applies exactly to solid solutions of the type formed by ketones in a pure hydrocarbon. In determining the constants in the relationship between relaxation-time and chain-length, however, reference was made to the experimental evidence from the solutions of the 'amorphous centre type' formed by esters in paraffin wax. Although their behaviour is similar to that of the ketone solutions, the application of the relationship to the latter would require modification of the constants involving the energy barriers between equilibrium positions of the polar molecules.

The measurements of tan δ were made with a *Q*-meter, using a sample-holder similar to that described by Hartshorn and Ward[5]. During measurement the temperature was 22° C. ($\pm$ 0·5° C.).

More complete results of this programme will be published elsewhere.

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[1] Jackson, W., *Proc. Roy. Soc.*, A, **150**, 197 (1935).
[2] Sillars, R. W., *Proc. Roy. Soc.*, A, **169**, 66 (1939).
[3] Pelmore, D. R., *Proc. Roy. Soc.*, A, **172**, 502 (1939).
[4] Fröhlich, H., *Proc. Phys. Soc.*, **54**, 422 (1942).
[5] Hartshorn, L., and Ward, W. H., *J. Inst. Elect. Eng.*, **79**, 597 (1936).

Variation of Standard Electrode Potentials with Temperature

Gilbert[1] has recently directed attention to the desirability in corrosion studies of being able to compare directly potentials measured at different temperatures.

The standard electrode potential of the silver/silver chloride electrode has been measured over a temperature range 0–60° C. by Harned and Ehlers[2], and they have shown that their results obey the empirical equation:

$$E^\circ_{(T)} = b + c(T - 298) + d(T - 298)^2 + f(T - 298)^3,$$

T being the absolute temperature, and b, c, d and f constants the values of which have been determined.

The value of E° at any temperature calculated from this equation represents, however, only the value of this potential balanced against the standard potential of the hydrogen electrode *at the same temperature*; that is,

$$E^\circ_{(T)} = E^\circ_{\mathrm{Ag/AgCl}\,(T)} - E^\circ_{\mathrm{H}\,(T)}.$$

In order to make any absolute comparison, it is necessary either (*a*) to calculate or determine experimentally the absolute change of E°_{H} with temperature, or (*b*) to assume this change to be zero. Gilbert has pointed out the difficulties of determining this change experimentally, and has asked whether assumption (*b*) may be made.

The following argument based on an analysis of the processes which take place in a cell of the type shown below would appear to make it clear that the potential of the standard hydrogen electrode (as that of any other electrode) does vary with temperature. (A cell rather than an individual electrode has been considered because of the doubt that exists in the conception of the absolute potential of a single electrode.)

Consider the cell

$$\begin{array}{cccccc} & - & & & & + \\ \mathrm{H_2} & | & \mathrm{H^+}\ (a=1) & \vdots\vdots & \mathrm{H^+}\ (a=1) & | & \mathrm{H_2} \\ 1\ \mathrm{atm.} & | & \mathrm{Temp.}\ T_1 & \vdots\vdots & \mathrm{Temp.}\ T_2 & | & 1\ \mathrm{atm.} \\ & E_1 & & & & E_2 & \\ & & \mathrm{I} & & \mathrm{II} & & \end{array}$$

Assume that current flows in the outside circuit from the electrode at T_2 to that at T_1, and that all thermo-electric effects in the leads and the effect of the liquid junction potential have been eliminated. At electrode I, hydrogen passes into solution as

hydrogen ions, and at electrode II the reverse process occurs.

The E.M.F. of the cell may be expressed as follows :

$$E = \frac{1}{F}\left\{[\tfrac{1}{2}(D_{H_2})_{T_1} + \tfrac{1}{2}T_1\,\Delta S_1 - NeI - (W_{H+})_{T_1}] - [\tfrac{1}{2}(D_{H_2})_{T_2} + \tfrac{1}{2}T_2\,\Delta S_2 - NeI - (W_{H+})_{T_2}]\right\},$$

where D_{H_2} is the heat of dissociation of hydrogen, that is, decrease in heat content, and ΔS the corresponding entropy change at the temperature shown; I represents the ionization potential of hydrogen, and W_{H+} the free energy of solvation of 1 gm.-ion hydrogen ions at the temperature subscribed. In so far as the constituent parts of the E.M.F. may be considered as belonging to the two electrodes individually, the potential of the hydrogen electrode at temperature T_1 is represented by the terms in the first square bracket, and that of the hydrogen electrode at temperature T_2 by the terms in the second.

The free energy terms considered above are unquestionably functions of temperature, and it follows, therefore, that the potential of the hydrogen electrode changes with temperature.

The above analysis of the electrode process, which is essentially that used by various authors including Butler[3], neglects, of course, all thermo-electric effects in the metal leads in the outside circuit and the contribution to the E.M.F. of the liquid junction potential, both of which effects would, it is presumed, be considerable.

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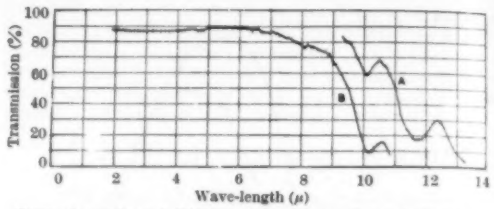
[1] Gilbert, P. T., Discussions of the Faraday Society, **1**, 320 (1947).
[2] Harned, H. S., and Ehlers, R. W., *J. Amer. Chem. Soc.*, **54**, 1350 (1932).
[3] Butler, J. A. V., "Electrocapillarity" (Methuen, 1940).

Absorption of Magnesium Oxide in the Infra-Red Region

IN 1935 Barnes, Brattain and Seitz[1], investigating the absorption of magnesium oxide in the infra-red, reported some forty or so fine absorption lines in the range from 6 μ to 15·6 μ. In 1934 Fock[2], using fumed magnesium oxide, had reported the eigen-frequency to be at 17·3 μ, with subsidiary maxima at 14·8 μ, 6·8 μ and 25 μ, but no fine structure. Such a fine structure was hitherto unknown for face-centred cubic crystals, though it has been reported for quartz[3] and calcite[4]. The theory advanced by these authors to explain the fine structure is based on the interaction of crystal vibrations as originally suggested by Born and Blackman[5]; but the assumptions which lead to the details of the fine structure do not appear to be correct[6].

This fine structure does not seem to be consistent with any form of lattice theory of infra-red absorption, and a further investigation, therefore, appears to have both theoretical and practical interest.

The curves reproduced here are typical results in the range up to 14 μ for specimens of different thickness. Values of the percentage transmission of cleaved specimens of artificially grown magnesium oxide, obtained from the same firm which supplied Barnes, Brattain and Seitz, were taken at a mean separation of 0·07 μ, using a large rock-salt prism spectrometer. Each point is the mean of two results



Curve *A*, specimen 0·075 mm. thick; curve *B*, specimen 0·467 mm. thick. Slit-width covers a band of approx. 0·1 μ. Vertical lines indicate probable error

obtained from two separate runs through the spectrum, and in no case did the values at any one wave-length differ by more than 2 per cent. Each result in each run is the mean of three results taken consecutively. Experiments showed that by using a Welsbach mantle as the source of radiation, the scattering within the apparatus is negligible; but that with a Nernst filament as a source some five to ten per cent of the radiation at 11 μ was due to scattering from the high-energy peak in the spectrum of the Nernst filament.

It will be seen that the fine structure reported by Barnes, Brattain and Seitz has not been confirmed. Two distinct subsidiary maxima have been found, one at 10·10 μ and the other at 11·7 μ.

The curves for various thicknesses are consistent with each other, that is, they all give the same value for the extinction coefficient at any one given wave-length. This is not the case in the results of Barnes, Brattain and Seitz, where the detailed shape of the absorption spectrum differs considerably for specimens of different thickness. Further, the curve for a specimen of 75 μ thickness (curve *A*) shows that it becomes practically opaque beyond 13·3 μ, while a specimen of the same thickness was found by Barnes, Brattain and Seitz to have at least 10 per cent transmission up to 15·6 μ, indicating that there must have been considerable scattering of the short wave-length radiation from their source, which was a heated platinum strip.

Preliminary results in the region from 14 μ to 25 μ show that the eigen-frequency is at 17·3 μ, as reported by Fock, with subsidiary peaks at 14·8 μ and 24·2 μ. The absorption maximum at 6·8 μ, found by Fock, has not been confirmed, and is probably due to absorbed water, as a cleaved specimen left out in the air for some weeks showed an absorption at 6·5 μ, which vanished as soon as the specimen was cleaned by rubbing with clean chamois leather.

To sum up, the fine structure observed by Barnes, Brattain and Seitz has not been confirmed. The eigen-frequency is at 17·3 μ, and there are subsidiary maxima on the short wave-length side of the eigen-frequency at 10·1 μ, 11·7 μ and 14·8 μ, and at 24·2 μ on the long wave-length side.

I should like to thank Dr. L. Kellner for suggesting the problem, supervising the practical work and giving much advice, and Dr. M. Blackman for advice and discussion.

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[1] Barnes, Brattain and Seitz, *Phys. Rev.*, **48**, 582 (1935).
[2] Fock, J., *Z. Phys.*, **90**, 44 (1934).
[3] Silverman, S., and Hardy, J. D., *Phys. Rev.*, **37**, 176 (1931).
[4] Silverman, S., *Phys. Rev.*, **39**, 72 (1932).
[5] Born, M., and Blackman, M., *Z. Phys.*, **82**, 551 (1933).
[6] Blackman, M., *Phil. Trans.*, **236**, 103 (1936).

Systematization of Certain Binary Metallic Equilibrium Diagrams

As part of an attempt to systematize the knowledge of factors which influence the form of binary equilibrium diagrams, we have examined the available data on binary systems in which no intermediate compounds are formed. This corresponds to a state of affairs where the electrochemical effect[1] is small, and if those systems characterized by a 100 per cent range of solid solubility are ignored, the systems considered fall into two distinct classes; namely, those in which a region of liquid immiscibility is encountered (Fig. 1), of which aluminium–potassium is an example, and those which are characterized by the existence of a eutectic (Fig. 2), of which bismuth–cadmium is an example.

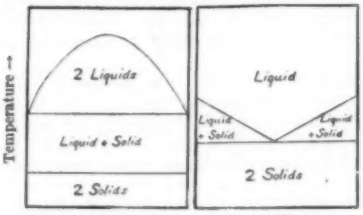


Fig. 1

Fig. 2

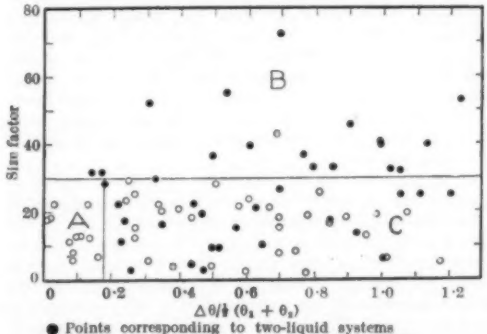
Fig. 1. The aluminium–potassium type of diagram
Fig. 2. The bismuth–cadmium type of diagram

In Fig. 3 we have plotted the size factor of each system, as defined by the relation

$$\text{size factor} = \frac{L - S}{S} \times 100,$$

where L is the closest distance of approach of atoms of the larger atomic species in crystals of the pure element and S is the corresponding value for the smaller atomic species, against a 'temperature factor' $\frac{\Delta\theta}{\frac{1}{2}(\theta_1+\theta_2)}$, where $\Delta\theta$ is the difference between the melting points of the elements and θ_1 and θ_2 are the melting point temperatures on the absolute scale.

Fig. 3 may conveniently be divided into three regions, A, B and C. In region A, where the size-factor and temperature-factor are limited by the values 30 per cent and 0·175 respectively, all systems are of a simple eutectic type (Fig. 2), in which the eutectic point is moderately near the centre of the composition scale. In region B, where the size-factor is everywhere greater than 30 per cent, we find that the two-liquid system predominates. It is, however, quite clear that although a large size-factor strongly favours the formation of a two-liquid type of diagram, size-factor is not the only controlling effect: in region C, for example, there is an approximately equal number of two-liquid and eutectic-type diagrams distributed randomly throughout the region. Moreover, in region B, the system germanium–lead is an outstanding exception to the general rule that a size-factor of more than 30 per cent is associated with a two-liquid type of diagram. This system[2] is characterized by a fairly flat liquidus curve and by having the eutectic point very near the composition of one of the pure metals; and if compared with Figs. 1 and 2, it may be regarded as being of an intermediate type.



● Points corresponding to two-liquid systems
○ Points corresponding to eutectic-type systems

Fig. 3

In view of the existence of this intermediate type of diagram, it is of interest to examine more closely the form of the eutectic-type diagrams in region C. In this region, as the temperature-factor increases from 0·175 to 0·4, the eutectic point moves progressively away from the centre of the composition scale and the diagrams approximate to the form of that for germanium–lead. When the temperature factor is greater than 0·4, the diagrams tend to be of the intermediate type already discussed.

It has not, in the present investigation, been possible to elucidate the factors which control the formation of two-liquid or eutectic-type diagrams in region C of Fig. 3; but it is clear that within this zone a large temperature-factor tends to be associated with a eutectic diagram of the intermediate type.

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[1] Hume-Rothery, W., *Inst. Metals Mon.*, No. 1 (1944).
[2] Briggs, T. R., and Benedict, W. S., *J. Phys. Chem.*, **34**, 173 (1930).

Instability in Pipe Flow

When considering the conditions necessary for the stability of laminar flow in a cylindrical pipe, it may be assumed that the following quantities are involved: transverse velocity gradient (dv/dx) at the point considered; distance (x) of the point from the wall; and kinematic viscosity (ν) of the liquid.

The dimensionless group arising from these quantities is

$$G = \frac{(dv)}{(dx)} \frac{x^2}{\nu} = x \cdot \frac{d}{dx} ({}_xRe) - {}_xRe,$$

where ${}_xRe$ is the localized Reynolds number $\frac{vx}{\nu}$.

In fully developed laminar flow the maximum value of G occurs when $x = d/3$, where d is diameter of pipe; and this maximum value is

$$G_{max} = \frac{8\bar{v}d}{27\nu} = \frac{8}{27} Re.$$

From the generalized velocity-distribution curves (for the flow near the entrance to a pipe) given by Nikuradse[1], it may be shown that the value of G_{max} increases downstream, as shown in Fig. 1, where X is downstream distance from the entrance. A value of about 2,000 is frequently assumed for the critical Reynolds number: the corresponding value of G_{max} is about 592.

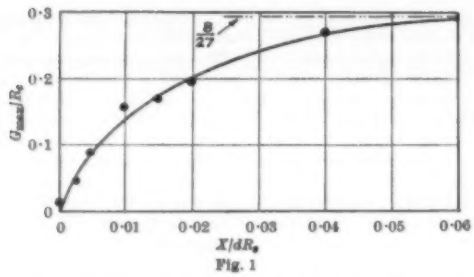

Fig. 1

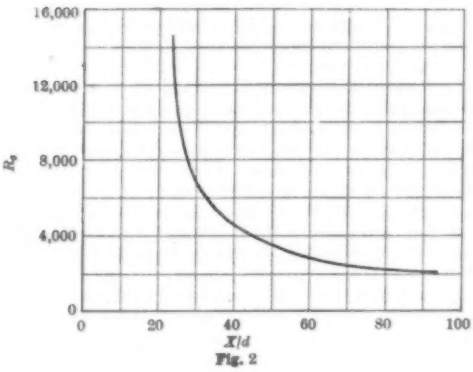

Fig. 2

Fig. 2 shows the variation of the position of the 'point of instability' ($G = 592$) as a function of Reynolds number (Re). From Fig. 2 it appears that this 'point of instability' approaches the entrance as the Reynolds number is increased.

The precise shape of the curve in Fig. 2 can, of course, only apply to flow examples in which the generalized velocity-distribution curves of Nikuradse are actually obeyed.

In Fig. 2, with flow at a constant Reynolds number, the position of the 'point of instability' is fixed. If disturbances arrive at this point, the flow should become turbulent; but if the disturbances have died away before they reach this point, laminar flow should persist. These inferences have an obvious bearing on the so-called 'higher critical' phenomena.

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[1] Nikuradse, J., *cit.* Prandtl, L., and Tietjens, O. C., "Applied Hydro- and Aero-Mechanics" (McGraw-Hill, 1934).

Fish Farming in the Belgian Congo

Dr. C. F. Hickling[1] recently gave a survey of fish farming in the Middle and Far East. He mentioned that the best results were obtained in Africa with species of *Tilapia* (Percomorphi, Cichlidæ). The study of fish-farming problems being one of the principal objects of the Fisheries Research Station at Elisabethville (Belgian Congo), it may be of interest to describe some of our observations and results.

Before trials of fish culture were made in the Belgian Congo, it was already known that some species of *Tilapia* lent themselves more or less to pond-culture. Local species were used in different parts of Central Africa: *Tilapia nigra* Gthr. in Kenya[2] and *Tilapia kafuensis* Blgr. in Northern Rhodesia[3]. In the Union of South Africa, trials were made with *Tilapia mossambica* Peters, *Tilapia Sparmani* A. Smith, *Tilapia nigra* Gthr., *Haplochromis moffati* Cast., and *Serranochromis thumbergii* Cast.[4]. The results published concern mostly the growth and the biology of these fish. Data about production are rather scarce. At the Station of Chilanga (North. Rhod.) a pond stocked with *Tilapia kafuensis* Blgr., where the fish were intensively fed, gave a production equivalent to 1,200 lb. per acre per annum (1,342 kgm. per hectare per annum).

Since 1943, trials with indigenous species of fishes of the Congo Basin have been undertaken in different parts of the country, especially in Elisabethville. Those scattered trials, by private enterprises, proved that some species of Cichlidæ are growing and breeding well in ponds. Unfortunately, the experiments were made with mixtures of different species.

The Mission Piscicole du Katanga (1946–47)[5] repeated the experiments, taking care to separate the species involved. Carrying on the work of the Mission Piscicole du Katanga, the Fisheries Research Station, Elisabethville, got some very interesting results.

Tilapia sparmani A. Smith and *Tilapia nigra* Gthr. (introduced previously from Kenya), although breeding in ponds, did not give satisfactory results. The best results were obtained with *Tilapia macrochir* Blgr. and *Tilapia melanopleura* Dum. We already know something about their breeding[6].

Like two good pond-fishes of the Far East, *Osphronemus olfax* Blkr. and *Ctenopharyngodon idellus* Cuv. and Val., *Tilapia melanopleura* Dum. is a plant-eater; two hundred fingerlings took no more than ten months to eliminate from a pond of 7 ares (0·17 acre) a dense vegetation of *Leersia hexandra*. The fish like also *Potamogetum*, *Hydrilla*, *Lagarosiphon*, etc., and eat very well boiled sweet potatoes, banana foliage and other greenstuff. T. Vaughan Jones[7], who last February, after a visit to our Station, took some fingerling *Tilapia melanopleura* to the Station at Chilanga, was able to confirm these observations.

Our experiments further indicate that *Tilapia melanopleura* is adaptable to different waters and withstands handling. *Tilapia macrochir* Blgr. is principally a plankton-eater. It does not eat weeds but likes the micro-organisms fixed upon it. Artificial feeding with mill waste gives excellent results.

Both species seem to have the same rate of growth (up to 250 gm. eleven months after being spawned). It is therefore not surprising that high yields can be obtained with these species. A pond of 85 ares (about 2 acres) was manured in July 1947 and 121 *Tilapia macrochir* weighing 10 kgm. put in. From March 1948 the fishes were fed with maize waste. Eleven months after the beginning of the experiment 4,000 kgm. of fish were collected, which is equivalent to 5,135 kgm. per hectare per annum (4,574 lb. per acre per annum).

It is easy to understand the economic value of these fishes in countries where food is rather scarce. They immediately transform the plankton and green plants into valuable foodstuffs. No materials of food value for man are needed for their artificial feeding. The two species, being of complementary feeding habits, are able to use a great part of all the available food in a pond. Their breeding habits are sufficiently different to avoid competition between them. Although we have already very interesting results

with mixed populations, the ratio of the two species is not yet fully determined for ponds of different productivity.

It may be of interest to direct attention to the fact that *Tilapia melanopleura* Dum. is a good agent in malaria control. The fish eliminate the floating and semi-submerged vegetation, which are breeding places of the malaria-carrying *A. gambiæ* and *A. funestus*. Further, the fry eat mosquito larvæ.

All over the country the cultivation of both these *Tilapia* is growing rapidly. Nearly all the ponds and dams are stocked with fry coming from the *Tilapia*-strains of this Station. Some fingerlings have already been sent abroad.

Further details concerning the biology and the culture of these *Tilapia* will be published in the annual report of the Station.

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[1] Hickling, C. F., *Nature*, **161**, 748 (1948).
[2] Copley, Hugh, Review of Kenya Fisheries (1947).
[3] Vaughan Jones, T., Game and Tsetse Control Dept. Ann. Rep. 1944.
[4] Union of South Africa, Inland Fisheries Dept., Ann. Rep. 1944.
[5] Huet, M., Actes du Congrès Limnologique, Suisse 1948 (in the press).
[6] De Bont, A. F., Halain, C. P., Huet, M., and Hulot, A., Min. des Col. Belgique (1948).
[7] Vaughan Jones, T., Game and Tsetse Control Dept. Ann. Rep. 1948.

Amino-Acids in the Hæmolymph of the Dragon-fly Nymph, *Aeschna cyanea*

ALTHOUGH it is well known that the non-protein nitrogen content of insect hæmolymph is high and that a large proportion of it is present as amino-acids, few investigations have been made as to their nature. Florkin and Duchateau[1] showed that the hæmolymph of *Dytiscus marginalis* contained small quantities of histidine and tyrosine, and reported the absence of arginine, tryptophane, phenylalanine and cystine. A more thorough analysis by Ussing[2] revealed the presence in the blood of *Melolontha vulgaris* of lysine, arginine, histidine, tyrosine, leucine, valine, tryptophane and almost certainly hydroxyproline. The latter is also present in the blood of *Oryctes nasicornis*.

We have investigated the hæmolymph of *Aeschna cyanea*, using the technique of partition chromatography on filter paper of Consden, Gordon and Martin[3].

Small quantities of blood (about 3 mm.^{3}) run on a partition chromatogram, using water-saturated phenol as solvent, gave coloured spots with ninhydrin, the R_F values of which (0·38 and 0·55) corresponded with those of glycine and alanine. With increased amounts of blood, spots corresponding in position to leucine or *iso*leucine, valine and proline were found.

To detect the presence of amino-acids occurring in smaller amounts, concentrated extracts were prepared by evaporating the blood from one larva (about 100 mm.^{3}) to dryness in a vacuum desiccator, suspending in about 15 mm.^{3} of 60 per cent alcohol, centrifuging, and using the supernatant solution. Thus the amino-acids were concentrated while the protein and most of the inorganic salts remained undissolved. The nitrogen content of the whole blood was determined by an ultra-micro-Kjeldahl method on a small sample (0·7 mm.^{3}) removed before concentration. A typical result was: total nitrogen, 529; protein nitrogen, 311; non-protein nitrogen, 218 mgm. per cent. Amino-acids identified: serine, glycine, lysine, alanine, tyrosine, valine, leucine or *iso*leucine, proline.

Since proline is easily recognized by its ninhydrin colour and because the R_F values were sometimes lower than expected, values for every spot were recalculated using the proline spot as standard (R_P value = 1·0).

The results were confirmed by running simultaneously a blood extract, and a blood extract to which was added one or more of the suspected amino-acids.

The results for a number of different animals are summarized in the accompanying table.

R_F-values at room temperature

Amino-acid	Pure amino-acid	Pure amino-acid in blood	Blood extract (animal 15B)	Blood extracts: average for 16 runs
Serine	0·36	0·36	0·37	0·36
Glycine	0·45	0·44	0·44	0·44
Lysine	—	0·55	0·54	0·53
Alanine	0·63	0·64	0·65	0·65
Tyrosine	0·70	0·72	0·75	0·72
Valine	0·85	—	0·87	0·86
Leucine or *iso*leucine	0·94	—	0·94	0·93
Proline	1·00	—	1·00	1·00

From these experiments and those with untreated blood it appears that glycine, alanine, valine and leucine are present in the greatest concentration. Proline and tyrosine occur in moderate amounts and serine and lysine in small quantities.

Confirmation of these results was provided by the two-dimensional technique using phenol and collidine as solvents, except that no serine was demonstrated. Arginine and lysine are possibly present, and relatively large amounts of a substance, possibly a peptide, which runs at the same speed as alanine in phenol but somewhat slower in collidine.

Further experiments are in progress on the blood of other insects, and attempts are being made to obtain quantitative results.

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[1] Florkin, M., and Duchateau, G., *Bull. Acad. Roy. Belg., Cl. Sci.*, **28**, 373 (1942).
[2] Ussing, H., *Acta physiol. Scand.*, **11**, 61 (1946).
[3] Consden, R., Gordon, A. H., and Martin, A. J. P., *Biochem. J.*, **38** 224 (1944).

Growth of *Culex molestus* under Sterile Conditions

Aedes ægypti and *Culex pipiens* are the only two mosquitoes which have hitherto been reared from egg to adult under sterile conditions. It is interesting to note that the autogenous *Culex molestus* can also be bred without difficulty on sterile media. The following media were found suitable for this purpose (all experiments were carried out at a temperature of 28° C.).

(1) Dried or fresh yeast (autoclaved) 1·2 gm. to 15 ml. distilled water to which 25 eggs of *C. molestus* were added under sterile conditions. On this medium the mosquitoes developed from eggs to adult in 10·5–13 days; but the adults were not viable.

(2) Water, dried yeast and the following vitamins: thiamin, riboflavin, pantothenic acid, niacin, pyrid-

oxin, folic acid (each 10 γ per ml.), biotin (0·14 γ per ml.). This was the optimum medium, and the development from egg to adult took 7·5 days. The mosquitoes were viable. Obviously 1·2 gm. of the best samples of yeast available did not contain sufficient of the above factors to produce viable adults.

(3) Liver extract and dried yeast (autoclaved) (Trager's medium for *A. ægypti*). Development from egg to adult took 14 days, and the adults were viable. Water extract of the same yeast and liver extract allowed development from egg to adult in 20 days; but the adults which emerged were not viable.

(4) Water, glucose (0·1 per cent), a mixture of salts (0·2 per cent), casein hydrolysate (2 per cent), the above-mentioned vitamin B complex (but with only 7·5 γ biotin per ml.) and ascorbic acid (150 γ per ml.). Although development on this medium was relatively slow (eggs to viable adults in 25 days) it proved to be the most suitable for studying the nutritional requirements of all stages of *Culex molestus*. Thus in the absence of pantothenic acid, all other factors being present, there was no development beyond the first instar; in the absence of thiamin, riboflavin or pyridoxin the larvæ die in the second instar; in the absence of folic acid, the larvæ reach the fourth instar but never pupate. In the absence of niacin, the whole developmental cycle lasts 42 days, and the adults are viable. In the absence of biotin the cycle lasts 36 days, but the adults are not viable. Ascorbic acid is not essential for complete development of viable mosquitoes, but in its absence the cycle is prolonged to 29 days.

It is interesting to note that the viable females raised on sterile media were autogenous and laid eggs in the absence of any kind of nutrition. Full details will be published elsewhere.

I wish to thank Prof. S. Adler for his advice and interest in this work.

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Receptor Organs in Tunicata

Nothing was known of tunicate receptors before 1899, when Herdman[1], in his description of *Ascidia*, mentioned a few structures that might act as receptors, but gave no proof or details. Lorleberg[2], on the other hand, stated in 1907 that in *Stylopsis* "there is complete lack of sense cells". Hecht[3] could not find any receptor organs besides the tentacles and margins of the siphons. Das[4] showed for the first time definite receptor cells in the test and mantle. He demonstrated red pigmented cells which act as photoreceptors. Besides these, the tentacles and dorsal tubercle have been mentioned by various workers as having definite receptor functions. I have found a new structure in *Ciona*, in the intersiphonal region, which appears like an eye-spot and is definitely a photoreceptor. No mention of this structure is found in the various accounts of *Ciona* given by different authors. This eye-spot can be easily seen when the atrial aperture is wide open. It lies on the wall of the mantle just behind the base of the atrial siphon on its dorsal aspect. It is specially conspicuous in dark-adapted animals.

I have made investigations on the receptor organs and the responses of the ascidians *Ciona*, *Ascidiella*, *Styelopsis* and *Herdmania*, to mechanical stimulation, gravity, light, temperature and osmotic pressure, a complete account of which is being published elsewhere. The main receptors in Tunicata are as follow:

1. *Tangoreceptors:* (*a*) cells scattered in the non-vascular areas of the test, especially the test of the siphons; (*b*) cells covering the ampullæ in the vascular areas of the test: (*c*) marginal cells, specially sensitive to vibrations of water or substratum, of the siphons; (*d*) tentacles. Stimulation of (*a*), (*b*) and (*c*) causes direct reflexes, while stimulation of (*d*) causes a crossed reflex.

2. *Photoreceptors:* (*a*) red pigmented squamous epithelium of the siphonal lining in all tunicates; (*b*) red-pigmented epithelium of the vascular ampullæ in Pyuridæ; (*c*) eye-spot in *Ciona*.

3. *Gusto- and olfacto-receptors:* (*a*) tentacles react to dilute acids, alkalis and different concentrations of sea-water; (*b*) dorsal tubercle—probably both for smell and taste (Metcalf and Hunter[5]).

4. *Rheoreceptors:* margins of the siphons—not only do the siphons bend to face a water-current, but they also bend upwards against gravity.

5. *Thermoreceptors:* the cells lining the siphons are very sensitive to changes in temperature, although the tentacles must also be an aid to the tunicate in registering temperature.

I have also demonstrated that, contrary to what was believed hitherto, Tunicata have positive as well as negative responses.

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[1] Herdman, L.M.B.C. Memoirs, **1** (1899).
[2] Lorleberg, *Z. Wiss. Zool.*, **89**, 212 (1907).
[3] Hecht, *J. Exp. Zool. Philadelphia*, **25**, 229 (1918).
[4] Das, *J. Morph., Philadelphia*, **59**, (3), 589 (1936).
[5] Metcalf and Hunter, *J. Roy. Mic. Soc.* (1901).

Site of Action of D.D.T. and Cause of Death after Acute D.D.T. Poisoning

Experiments were carried out with *Periplaneta americana* and *Rana esculenta*, after injection with a D.D.T.-emulsion. Action-potentials from the n. cruralis (= 5th nerve, Pringle) of the second thoracic ganglion of *Periplaneta* were recorded with a special pre-amplifier and a cathode-ray oscillograph. No differences were found between normal and D.D.T.-treated animals in the following preparations: (1) crural nerve only connected with the second leg; (2) crural nerve only connected with the second thoracic ganglion, which was isolated from the other ganglia and from all peripheral nerves. Hence the D.D.T. causes no increase of spontaneous activity of the sense organs of the leg, nor of spontaneous motor-activity from the isolated ganglion. However, when the reflex path was intact (or partly intact—crural nerve connected with second leg and second thoracic ganglion), the action-potentials of D.D.T.-treated animals showed an abnormal increase in frequency.

These facts suggest that the specific action of D.D.T. is a facilitation of synaptic transmission. A direct proof of this assumption can be given with a 'spinal frog', where the homolateral contraction of the m. gastrocnemius was recorded after stimulation of the peripheral stump of the n. ischiadicus, and the contralateral reaction (through the spinal cord) after stimulation of the central stump of the same nerve. It is well known that a contralateral response does not follow one single induction shock; two or even

more shocks being necessary to activate the motoneurones. After D.D.T. treatment, however, one single stimulus, even a weak one, induces a high contralateral contraction. This phenomenon was studied in a wide variety of experiments, with different kinds of stimulation. These experiments show that the specific cause of D.D.T. symptoms is a facilitation of synaptic transmission. The question arises whether this fact can explain the cause of death after D.D.T. poisoning.

The answer is given by the same kind of experiments, carried out at a later stage of poisoning. The preparations then fail to give any contralateral response, even after faradic stimulation, while stimulation of the peripheral stump of the sciatic nerve (of the same animal) causes a normal reaction. Thus, a period of synaptic facilitation is followed by a synaptic block. This synaptic inhibition is, of course, not restricted to the sciatic region of the spinal cord, but represents a general blocking action of D.D.T., which causes the death of the animal.

The production of central inhibition could also be recorded with *Periplaneta*, although it takes a longer time to become perceptible. Besides the action of D.D.T. on the central nervous system, there is evidence of a specific action on the myoneural junctions or on the muscles of the leg of the cockroach. This will be discussed elsewhere.

On the other hand, D.D.T. had no specific action on the sense organs of the leg of *Periplaneta* or *Rana* (either skin-receptors and proprio-receptors), or on the peripheral nerves, or on the electro-encephalogram of *Rana*.

Experiments to detect any action of D.D.T. on the spontaneous activity of the nerve cord of *Periplaneta* are in progress, although the facts mentioned above make the existence of such an action improbable.

These investigations were carried out under the auspices of the National Council for Agricultural Research (Toegepast Natuurwetenschappelijk Onderzoek). Details of the work will be published elsewhere.

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Occurrence of *Acanthocephalus ranæ* Schrank. in Great Britain

Acanthocephalus ranæ Schrank. (= *Echinorhynchus ranæ* Schrank. = *Echinorhynchus hæruca* Rudolphi.), the only known Acanthocephalan parasite of the frog, has rarely been found in Great Britain. The only known recorded occurrences are by Elmhirst[1], who found it in the common frog *Rana t. temporaria*, and Baylis[2], who records its occurrence from Westmorland in a 'newt' and in the common toad.

Twenty-seven specimens were discovered in the duodenum of a single frog (*Rana t. temporaria*) during a routine dissection in November 1947. Unfortunately, frogs from two localities were mixed before examination, and the infected frog may have come from either Carnki (Cornwall) or from Newdigate (Surrey). Nineteen of the individuals were measured while still alive, and were found to consist of both males and females; males 7·0–10·0 mm., females 17·0–35·0 mm. Of the nineteen individuals determined, seven were males and twelve females. Mature eggs were present in all the females examined, and were extruded from one specimen on removal to saline. None of the males had the bursa copulatrix extruded, and all were hanging free in the lumen of the duodenum when discovered.

In the few individuals examined, the number of proboscis hooks and longitudinal hook-rows corresponded with the results of Lühe (*vide* Meyer[3]) for German specimens—females having 18 longitudinal rows and the males 13 longitudinal rows, with four to six hooks in each row—rather than with the figures given by Van Cleave and Porta (*vide* Meyer[3]). Van Cleave found in four individuals examined 12 longitudinal rows with six to seven hooks in each row, and this appears to agree with Porta's figures[4].

Although the recorded instances of the occurrence of this parasite seem to be rare, this may be due to lack of observation. In Germany and Austria the parasite is common in newts, toads and salamanders, as well as in the common frog. Heavy infections in *Rana t. temporaria* L. (as much as 50 per cent) occur in Germany[3]; but it appears to be much less common in France and Italy. It has been recorded only once in North America (Van Cleave[4]) from *Diemyctylus viridescens* at Baltimore, Maryland. Van Cleave considered the parasite to be rare in North America, as subsequent examination of Amphibia failed to reveal further specimens. This rarity is possibly correlated with the absence of the secondary host *Asellus aquaticus* L., which though common throughout Europe has been recorded in America only in Labrador and at Hopedale[5]. *A. ranæ* was recorded from the Dnjepr by Kostylew (*vide* Meyer[3]), in 1926.

It is hoped that further research and more careful observation of British Amphibia will throw more light on the distribution of this interesting species.

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[1] Elmhirst, R., *Glasgow Naturalist*, **4**, 89 (1912).
[2] Baylis, H. A., *Ann. and Mag. Nat. Hist.*, (11), **4**, 497 (1939).
[3] Meyer, A., "Bronn's Klassen und Ordnungen des Tierreichs", **4**, Abt. 2, 145 and 283 (1933).
[4] Van Cleave, H. J., *J. Parasitol.*, **1**, 175 (1915).
[5] Richardson, H., *Bull. U.S. Nat. Mus.*, No. 54 (1905).

Colpomenia sinuosa (Mert.) Derb. et Sol. in Scotland

I WISH to record the finding of *Colpomenia sinuosa* (Mert.) Derb. et Sol., near Stornoway in the Isle of Lewis. The plants were found growing in shallow pools on *Corallina officinalis* L. at Aignish, on the Broad Bay side of the Eye Peninsula in July 1947.

The first record of this alga in Scottish waters was made by Dr. M. D. Dunn[1], who found it at St. Andrews in the summer of 1938. As it is now known to occur all round the Irish coast[2], these two Scottish records show that it may also be found elsewhere on the coast of Scotland.

I would be pleased to hear of any other Scottish stations for this alga, so that its distribution in Scotland may be known.

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[1] Dunn, M. D., *Trans. and Proc. Bot. Soc. Edin.*, **32** lv (1939)
[2] Brennan, A. T., *Irish Nat. J.*, **8** (1945). Blackler, M. C. H., *Irish Nat. J.*, **6**, No. 8 (1937); **7**, Nos. 7 and 8 (1939). Lynn, M. J., *Irish Nat. J.*, **5**, No. 2 (1935). Rees, K., *J. Ecol.*, **23**, No. 1 (1935).

Abnormal Serum Protein in Parenchymatous Liver Diseases

SEVERAL colloidal serum reactions have been proposed during recent years for revealing damage of the liver parenchyme: the cephalin-test (Hanger), the colloidal gold and thymol tests (Maclagan) and the colloidal benzoin and shellac tests[1]. Most authors suppose that increased gamma-globulin forms the basis of these tests, but it has been suggested that beta-globulin may be responsible, too.

In fractionation experiments with variable concentrations of alcohol at low temperature (5–10° C.), we found that normal sera caused precipitation only in alcohol concentrations higher than 20 per cent; sera of hepatic cases, on the other hand, gave precipitations in 5–10 per cent alcohol. No precipitation occurs when alcohol is diluted with 0·9–10 per cent sodium chloride or when twice-distilled water is added without alcohol, or when the *p*H of the diluted alcohol is less than 5·5.

The protein fraction precipitated with 10 per cent alcohol is insoluble in water, but is readily soluble in 0·9 per cent sodium chloride; it is partly precipitated with 30 per cent saturated, and completely precipitated with 50 per cent saturated, ammonium sulphate. Saturated sodium chloride solution precipitates the greater part of it. The iso-electric point is about *p*H 5·5. The tryptophane content varies between 3·0 and 3·8 per cent. The serum concentration of this fraction, present in all cases of parenchymatous hepatic damage, amounts to 1–3 per cent, forming a considerable part (30–50 per cent) of the total globulin.

The purified fraction gives positive colloidal gold, benzoin and Takata tests of the same intensity as does the corresponding quantity of serum; with the remaining, non-precipitable protein, colloidal tests give negative results. The effect of the isolated fraction on thymol turbidity is somewhat less than that caused by the corresponding quantity of serum. In Weltmann's coagulation test, on the other hand, the isolated fraction is coagulated in presence of 0·1 per mille calcium chloride; the higher values (0·2–0·4 per mille calcium chloride) obtained with total serum are the consequence of some unknown factor hindering coagulation.

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[1] Fischer and Wiltner, *Acta. med. Scand.* (in the press).

Increased Muscle Phosphorylase Activity in the Starved Rat

IT was shown earlier that glucose uptake in the isolated rat diaphragm was reduced after a period of non-carbohydrate, high-fat diet[1], and that a spontaneous regulation of food intake took place in animals shifted from such a diet to a high-carbohydrate diet[2]. These physiological changes occurring after a period of carbohydrate deprivation, together with many other observations after starvation or fat-feeding by other investigators, suggest that the kind of foodstuff taken by the animal (or human subject) determines in some way the metabolic pattern.

It is known that a decrease in insulin content of the pancreas is found after starvation or following a fat diet[3]. Many observations seem, however, to point to the fact that the change in the metabolic pattern can take place independently of the hormonal status, for example, the dependence of the glucose-tolerance curve[4,5] and the rate of depletion of glycogen stores[6] on the previous carbohydrate intake in the hypophysectomized animal. It is conceivable that a difference in cellular enzymatic activity is found in different metabolic conditions.

To investigate this problem we have undertaken a study of muscle phosphorylase activity in fed animals, in starved animals, and in animals on diets containing different amounts of carbohydrate. The results obtained in fasting animals will be given briefly here.

Phosphorylase activity was studied by the method of Cori, Cori and Green[7], determining the liberation of phosphate during the process

glucose-1-phosphate → glycogen + phosphate.

A crude extract of rat muscle was made after freezing with liquid air. The extract was filtered, adjusted to *p*H 6·1, and dialysed against running tap water. The dialysed extract was diluted with a weak solution of cysteine and added to tubes containing glucose-1-phosphate, glycogen and cysteine-glycerophosphate buffer. To some tubes adenylic acid was added. The tubes were agitated for one hour at 31° C. in a Warburg bath. After treatment with trichloracetic acid and filtering, the phosphate formed during the incubation period was determined as the difference between a zero value and a 60-min. value. The protein content of the enzyme extract was estimated by the biuret method, standardized against human serum. In each experiment the muscle phosphorylase activity was observed in one fed and one fasted animal.

The effect of fasting is shown in the accompanying table. The activity, both with and without adenylic acid, is consistently higher in the fasted animals.

Muscle phosphorylase activity in fed and fasted rats

Fed				Fasted			
Number of experiment	Phosphorus liberated (γ) 1*	2†	Protein in reaction mixture (mgm.)	Phosphorus liberated (γ) 1*	2†	Protein in reaction mixture (mgm.)	Duration of fast (days)
1	132	256	—	708	862	—	2
2	80	304	5·8	304	278	6·2	3
3	34	56	5·6	174	214	5·4	2
4	170	540	5·2	618	632	5·2	3
5	33	75	5·8	284	412	5·4	1
6	12	170	6·4	198	282	5·8	5
7	54	246	6·6	374	744	6·6	2
8	44	146	5·6	164	298	6·0	2

*Without added adenylic acid. †Adenylic acid added.

We are not suggesting, at present, any definite explanation for the higher phosphorylase activity in the starved animals. Studies are now being conducted on the phosphorylase activity during refeeding after fasting, in animals on diets containing different amounts of carbohydrate, and in animals shifted over from a low- or non-carbohydrate diet to a diet containing large amounts of carbohydrate (starvation diabetes). It is proposed to investigate other enzyme systems in intermediary carbohydrate metabolism, for example, the hexokinase system and the system of oxidative phosphorylation in animals on different dietary regimes.

The results obtained appear to indicate profound changes in the pattern of intermediary carbohydrate

metabolism depending upon the previous food intake of the animal. They may help towards a better understanding of the factors governing the metabolic pathways on different diets, and especially the many facts accumulated on the effect of fasting or fat-feeding on carbohydrate metabolism. In general, they stress the importance of ascertaining the nutritional status of the animal in carrying out enzymatic studies.

A detailed report will appear elsewhere. We wish to express our appreciation to Prof. E. Lundsgaard for his interest and helpful counsel in conducting these experiments.

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[1] Lundbæk, K., and Stevenson, J. A. F., *Fed. Proc.*, **7**, 75 (1948).
[2] Lundbæk, K., and Stevenson, J. A. F., *Amer. J. Physiol.*, **151**, 530 (1947).
[3] Best, C. H., Haist, R. E., and Ridout, J. H., *J. Physiol.*, **97**, 107 (1939).
[4] Heinbecker, P., Somogyi, M., and Weichselbaum, T. E., *Proc. Soc. Exp. Biol. and Med.*, **36**, 802 (1937).
[5] Foglia, V. G., and Potick, D., *Rev. Soc. Arg. Biol.*, **17**, 289 (1941).
[6] Samuels, L. T., "Recent Progress in Hormone Research", **1**, 147 (1947).
[7] Cori, C. F., Cori, G. T., and Green, A. A., *J. Biol. Chem.*, **151**, 39 (1943).

A Simple Method for Direct Comparison of the Depressant Effect of the Barbiturates on the Respiration and Circulation

IN 1926, Knaffl-Lenz[1] introduced a method for the bioassay of digitalis preparations by determining the minimal lethal dose on intravenous injection in anæsthetized guinea pigs. The method, which may be used for all kinds of cardiac glucosides, has since become official in, for example, Britain[2] and Sweden[3]. According to this procedure, the solution to be tested is introduced into the vena jugularis under constant pressure and at constant speed (either from a burette with a Mariotte stopper or with a motor-driven injection apparatus). The lethal dose is determined by direct observation of the cardiac standstill (concerning the details of the procedure, see, for example, Burn[4], Fønss Bech[5] and Goldberg[6]). The number of animals required is determined by the degree of accuracy one wishes to give the results; this may be calculated with the help of the usual statistical methods.

A similar method can also be used for comparison of the depressant effect of the barbiturates on the respiration and circulation. The guinea pigs in this case are anæsthetized with urethane. The dose required to produce cessation of the respiration may be ascertained by direct observation, although a self-registering device is, of course, also possible. When respiration ceases, the dose and time are noted, the thorax is opened and artificial respiration by a previously prepared connexion between the trachea and a Sterling pump is started. The cessation of cardiac activity is observed as in the Knaffl-Lenz method, and the dose and time required are noted. The doses required for the cessation of respiration and cardiac activity are thus determined on one and the same animal. The concentration of barbiturate, which must be in solution in the form of an alkali salt, is such that the dose required for the cessation of cardiac activity will be about 1 ml. per 100 gm. body-weight. The suitable rate of injection will then be approximately 0·5 ml. per min.

Doses required to produce cessation of respiration and circulation in guinea pigs after intravenous injection of some common barbiturates

Barbiturate	Concentration (per cent)	No. of animals	Dose for respiratory standstill (*R*) (ml./100 gm. body-weight)	Dose for cardiac standstill (*C*) (ml./100 gm. body-wt.)	*R*/*C* (as percentage)
Sodium 5-*iso*-amyl-5-ethyl-barbiturate ('Amytal sodium')	2·75	17	0·18±0·019	0·75±0·019	24
Sodium *N*-methyl-cyclo-hexenylmethyl barbiturate ('Evipal sodium')	2·2	7	0·055±0·015	0·98±0·039	6
Sodium *iso*propyl-*β*-brom-allyl-N-methyl-barbiturate ('Narkotal')	2·2	14	0·055±0·0042	0·72±0·030	8
Sodium 5-ethyl-5-(1-methyl-butyl)-thio-barbiturate ('Pentothal sodium')	1·2	9	0·058±0·0057	1·02±0·048	6

A simple method for such comparisons is of great practical value, since it has proved that the depressant effect of the barbiturates on the respiration has shown a tendency to increase if their duration of action is diminished.

In the accompanying table are given the results of a number of experiments using the method described. 'Amytal', with its moderate duration, has been compared with intravenous anæsthetics of ultra-short duration, such as 'Evipal', 'Narkotal' and 'Pentothal'. The depressant effect on the respiration of the last three preparations when injected intravenously is, as seen from the table, both absolutely and relatively in a totally different class from that of 'Amytal'. The dose required for cessation of circulation is in the case of 'Amytal' about four times as great as the dose inhibiting the respiration, while the corresponding value for the three other compounds is about fifteen times.

The importance of artificial respiration after cessation of spontaneous respiration under intravenous barbiturate anæsthesia is demonstrated, in short, in an extremely striking way. The margin between cessation of respiration and cardiac activity respectively brought about by compounds of the 'Amytal'-type is not as favourable for a successful treatment with artificial respiration, although this is far from insignificant. For these preparations, which are chiefly used in ambulant practice and are administered by mouth, the considerably smaller absolute toxicity on the respiratory centre is of all the greater importance. It is, of course, as a matter of fact, this form of toxic effect which determines the practical usability of the ordinary hypnotics.

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June 20.

[1] Knaffl-Lenz, E., *J. Pharm. Exp. Ther.*, **29**, 407 (1926).
[2] "Brit. Pharm.", 623 (1932).
[3] *Pharm. Suec.*, **11**, 788 (1946).
[4] Burn, J. H., "Biologische Auswertungsmethoden", 180 (Berlin, 1937).
[5] Fønss Bech, P., *Dansk Tidskr. Farm.*, **16**, 57 (1942).
[6] Goldberg, L., *Acta Physiol. Scand.*, **4**, 178 (1942).

Esterification of Phthalic Anhydride with Primary Alcohols at Room Temperature

In a recent publication[1], some investigations on the esterification-rate of dibasic acid anhydrides with primary alcohols at room temperature were recorded. From the results of titration of acid anhydrides dissolved in the cold in primary alcohols, using a solution of potassium hydroxide in the alcohol as titrating agent, it was concluded that mono-ester formation was instantaneous and quantitative, being so rapid that comparison of rates of reaction was impossible.

We have attempted to utilize this apparently instantaneous reaction in the preparation of certain half-esters of phthalic acid, but soon discovered that the expected product was only obtained in very small yields, if at all. Even after prolonged periods, substantial amounts of unchanged phthalic anhydride were recovered from the mixture. Titration of the mixture by the method of Siegel and Moran did, however, give results in agreement with the formation of a half-ester.

We consider that these apparently contradictory findings become reconciled if the esterification reaction is catalysed by the addition of the titrating agent. It is therefore incorrect to conclude that mono-esterification of a dibasic acid anhydride with a primary alcohol proceeds instantaneously and quantitatively at room temperature, as it only does so after the addition of potassium hydroxide, that is, in the presence of a catalyst.

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[1] Siegel, E. F., and Moran, M. K., *J. Amer. Chem. Soc.*, **69**, 1457 (1947).

Photolysis of Organic Disulphides

The reactions following light absorption by pure organic disulphides in solution have not been studied, although the reactions are of great importance in the chemistry of wool, affecting both felting and shrinkage of the wool[1,2]. Similar reactions occur in irradiated milk[3] and in petrol[4].

The absorption spectra of diphenyl-, di-*o*-tolyl-, and di-*p*-tolyl- disulphides were found to be similar. Absorption occurred below *c.* 3,000 A., with $\lambda_{max.} =$ 2,450 A.

Solutions of all three in organic solvents, as well as cystine in 3 per cent hydrochloric acid, were exposed to filtered light from a 125-W. mercury vapour street lamp from which the glass envelope had been removed. Measurements of the light flux by uranyl oxalate actinometry gave results in good agreement with those obtained using a thermopile–galvanometer combination. It was found that the disulphides were converted into the corresponding thiols, identified by the melting points of their metallic derivatives and estimated by amperometric titration with silver nitrate. The solvent was variously alcohol, *n*-hexane and ether.

In view of the theory[1,2] which accounts for the acidity developed in irradiated wool by the presence of sulphuric acid produced from hydrogen sulphide, which in turn came from a disulphide by photochemical reaction, tests were made repeatedly to determine whether hydrogen sulphide was a product in these reactions also; but no trace of any was found. Nor was sulphur a product, air having been excluded from the reaction vessel.

The quantum yield of thiol formation was 0·046 ± 0·003 for diphenyl-, di-*o*-tolyl- and di-*p*-tolyl-disulphides respectively, and 0·020 for cystine in hydrochloric acid. It was independent within experimental error (*a*) of the nature of the aryl group, (*b*) of the concentration of the disulphide, and (*c*) of the nature of the solvent used. The lower value for the cystine is explained by the simultaneous liberation of ammonia in this case[5].

The following mechanism is adequate if a free radical *R*—S— be assumed formed, as has been done in another case[6]. Free-radical formation is energetically possible with light of wave-length less than 4470 A., taking the energy of the SS bond to be 63·8 k.cal./mole.

$$R\text{—S—S—}R \xrightarrow{h\nu} R\text{—S—S—}R^{*} \quad (A)$$
$$R\text{—S—S—}R^{*} \rightarrow 2\,R\text{—S—} \quad (B)$$
$$R\text{—S—} + M \rightarrow R\text{—SH} \quad (C)$$
$$R\text{—S—S—}R^{*} + M \rightarrow R\text{—S—S—}R, \quad (D)$$

where *M* is a solvent molecule. Reaction *D* explains the fact that the quantum yield of thiol formation is less than 1. Its value indicates that an activated molecule has one chance in 44 of decomposing before it is deactivated by collision.

I am indebted to the Commonwealth Research Committee for a grant which made possible the purchase of equipment used.

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July 5.

[1] McMahon, P. R., and Speakman, J. B., *Trans. Farad. Soc.*, **33**, 844 (1937).
[2] Harris, M. L., and Smith, A. L., *J. Res. Bureau Standards*, **20**, 563 (1938).
[3] Flake, J. C., Jackson, H. C., and Weckel, H. G., *Chem. Abs.*, **35**, 2228 (1941).
[4] Morrell, J. C., Benedict, W. L., and Egloff, G., *Ind. Eng. Chem.*, **28**, 122 and 448 (1936).
[5] Lieben, F., and Urban, F., *Biochem. Z.*, **239**, 250 (1931).
[6] Waters, W. A., "Chemistry of Free Radicals", 73 (1946).

"Pre-Natal Physiology"

In his comprehensive and excellent review of Sir Joseph Barcroft's "Researches on Pre-Natal Life" which appeared in *Nature*, **159**, p. 383, Dr. F. H. A. Marshall makes the following statement: "With regard to the matter of permeability the author finds that, contrary to the views of Flexner, the greater the number of layers in the fœtal barrier, the more perfect is the fœtus at birth, . . .". On page 5 of his book, Sir Joseph states that my colleagues and I were interested in placental permeability rather than placental 'efficiency'. I should like to point out that we have made no statements about a possible correlation between placental structure and the maturity of the fœtus at birth, and there is consequently no conflict with Sir Joseph's views on this matter.

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ATOMIC ENERGY AND SOCIETY

THE conference of the Atomic Scientists' Association on "Atomic Energy and Society" and "Atomic Energy and the Scientist" was held in the Beaver Hall, London, on October 30. A number of distinguished men of science addressed the conference, and their speeches were followed by a general discussion. While there was general agreement on questions of scientific fact, the different speakers placed widely different interpretations upon the present national and international difficulties with regard to control, secrecy and individual freedom, which reflected to a large extent their different political outlooks. Prof. R. E. Peierls in his opening remarks emphasized that the Association as such does not adhere to any particular political philosophy; its primary function is to spread a knowledge of the facts and to provide a platform for informed discussion.

The prospects for the use of atomic energy in peace were reviewed by Prof. M. H. L. Pryce. Radioactive isotopes, manufactured in atomic piles, have already proved of great value, particularly in medicine and in biological and chemical research, for tracing the course of reactions by the principle of marked atoms. These applications require relatively small quantities of radioactive materials; the present Harwell pile should be able to satisfy all European needs. On the other hand, for the generation of electric power in quantities sufficient for industrial purposes, much larger quantities of fissile material would be needed —quantities that could readily be used for the construction of bombs if required. Many technical problems remain to be solved before atomic power plants can be put into operation, and it is not yet certain that adequate supplies of the nuclear fuel can be obtained, either by separation of uranium-235 from natural uranium or by the process of 'breeding' from uranium-238, or from thorium. The atomic age may still be half a century away.

Prof. P. M. S. Blackett gave what he described as a 'hard-bitten' analysis of the probable effects of atomic bombs in future warfare. For some time to come, bombs would be delivered to their targets by conventional aircraft, which would presumably have to operate hundreds of miles over enemy territory, subject to attack by much faster jet fighters. With an assignment of at least ten planes for each target to give mutual protection, the number of aircraft required to launch a surprise 'annihilation' raid against a country's industrial centres would be several thousand; preparations for an attack on such a scale could be detected and would lead to reprisals. The effect of a single atomic bomb was equivalent to about 2,000 lb. of ordinary bombs; but more than 1,000,000 lb. of bombs were dropped on Europe in the Second World War without by themselves causing Germany to surrender. Russia suffered far more severely than that from the German occupation, yet was able to fight on to victory. Thus, in Prof. Blackett's opinion, it cannot be assumed that atomic bombs would bring rapid or even eventual victory in a 'preventative war', and to embark on a preventative war, or conduct diplomacy by using it as a threat, would be very dangerous and could only be a counsel of despair.

The next speaker was Sir George Thomson, who gave an account of the prolonged negotiations for the control of atomic energy which had taken place in the United Nations Atomic Energy Commission and in its technical committee, on which he was the British representative. Only once was this committee able to sign a unanimous report; but this report did contain the vital statement that control is technically feasible. For the rest there had been interminable wrangling. The Russians would begin with obviously impossible demands, such as the one that the United States should destroy its stock-pile before control was established, and then make grudging concessions so late that the other Powers had some cause for doubting their sincerity. Nevertheless, Sir George thinks it is essential to continue the attempt to establish control, so that a country might have at least the security of a few months warning if an attack with atomic bombs was being prepared against it.

Prof. N. F. Mott referred to the need for maintaining contact so far as possible with scientific workers in the U.S.S.R. and other countries. He agreed with Prof. Blackett that the use of atomic bombs would not bring speedy victory in another war, and pleaded for moderation and a spirit of compromise in the negotiations. The extremists were beyond the reach of argument; but ordinary people could be made to understand that there are common needs transcending all our differences.

In the discussion that concluded the first session, Dr. E. U. Condon, a welcome visitor from the United States, commented on the widespread belief that military strength is our only defence against Communism. He believed it is equally important to have a positive social policy, to show in practice that Western democracy provides a better and happier way of living. Other speakers asked Prof. Blackett to elaborate some of his points, and there was both criticism and defence of his allegedly 'pro-Soviet' outlook. The question of the control of bacteriological weapons was also raised: Sir George Thomson replied that he believed control would be far more difficult in that case, and that it would probably be best to make a beginning with atomic energy by itself.

The second session of the conference was concerned with the effect which the development of atomic energy has had upon the individual scientific worker. Prof. Peierls described the difficult position which many men of science now occupy. On one hand, they are entrusted with secret information that affects national security; on the other hand, they belong to the international community of science, which is pledged to the free exchange of ideas. It has been possible to maintain this dual role only because at present the information which has to be kept secret does not have any particular bearing on the fundamental problems which interest the pure scientist. Information must be either secret or wholly international; it cannot be restricted, for example, to the west of the Iron Curtain. The participation of Eastern scientific workers in helping to solve our fundamental problems would always be welcome, even though they, like ourselves, might not be permitted to discuss certain things. We must accept the professional work even of individual scientific men whose personal political integrity may be in doubt; and in Britain, while the military authorities must decide whom they can trust with military secrets, scientific workers

doing ordinary academic work should have the same freedom as other citizens, if individual liberty is to be preserved.

Sir Henry Dale described the progressive restrictions which have been imposed on the freedom of science in the last fifty years, in consequence of its increasing military importance. He said that the ideal of complete freedom should be strenuously maintained, and that in the present difficult circumstances the boundary between the free and the secret knowledge should be kept as sharp as possible. One of the most distressing features of the present time, he said, is that scientific men in some countries are required not merely to conform to a political orthodoxy but also to uphold specific scientific doctrines for political rather than scientific reasons. A notorious instance is the genetics controversy in the U.S.S.R., in which the opponents of Lysenko, in particular Vavilov, have been dismissed from their posts or disappeared. Where scientific men are bound in their professional views by political considerations, scientific co-operation is obviously impossible.

Dr. E. H. Burhop considered that the type of interference with individual freedom represented by the Thomas Committee on Un-American Activities is a serious danger in the Western world. The conference ended with a lengthy discussion, devoted largely to the points raised by Sir Henry Dale on scientific freedom in the U.S.S.R. and on the merits of Soviet genetics.

H. R. ALLAN

THE PLACE OF BIOLOGY IN A CURRICULUM*

By PROF. H. GRAHAM CANNON, F.R.S.

IN the teaching of biology there are two sharply defined aspects: there is the study of the structure of organisms correlated with their functioning, leading to knowledge of human physiology and the relation of man to the animal and plant kingdom. This may be looked on as a factual aspect while, on the other hand, there is the study of evolution and all that it implies and involves. This may be regarded as a cultural aspect.

To take the factual aspect first. If there is one thing more than any other with which a child is intimately associated it is with its own body. Its body should become its immediate concern, and all school children, whatever other subjects they may study, should be taught to understand in a simple manner its mechanism and structure. But this is far from being the case, for we still live in an age of extraordinary prudery in which it is improper to discuss anatomical and functional details. This is brought out only too clearly when it is realized that there are no words in ordinary use to describe such natural processes as defæcation or micturition, and as regards the parts of the body, there are no names in ordinary use for the external genital organs. Any words there may be are considered completely vulgar. Now a general elementary study of the human body taken as an ordinary subject for study, quite apart from the educative value that the child derives from knowing what happens inside its own body when, say, a meal is taken, or when a schoolboy collapses exhausted after a hundred yards sprint—quite apart from this, the mere fact of taking this sort of study along with his history or his language or his science would make him feel that here is something quite ordinary and not in any way exceptional. He will then feel free to discuss biological things, things about himself, in an open manner, just as he would without hesitation discuss a problem of mechanics or history. In many schools it is the custom to have a visiting teacher, often a doctor, who appears spasmodically to give short courses of lectures to the older students on what is sometimes called 'personal hygiene'; but this is all wrong. He comes to talk to the students about sex, and that is where the harm is done. Why should sex be singled out like this? Why separate the gut from the genital system? We professional biologists do not, and neither do university biological students. It is this separation of the problem of the human body from the other subjects of study that tends to reinforce the Victorian prudery that we have inherited and to retain those awkward complexes resulting from suppressions which are the curse of adolescent education.

Now as regards biology as a cultural subject, this is the aspect that I consider of such value to the student who is to specialize on the Arts side. All syllabuses, whether good or bad, start from the 'lower' or structurally simple and lead up to the 'higher' or complex advanced types. If this evolutionary story is properly dealt with, not as a series of separate steps but rather as a gradual unfolding from simple beginnings of the complex organisations that we see at the top of the tree, then a student derives a new conception of life as a whole. He realizes that it is not only animals and plants that have evolved, but also all other things such as food and clothes, houses and motor-cars and, more important still, mental and social activities. Civilization, in fact, that he sees around him, he realizes is something that has gradually evolved and which he has inherited. The effect of this broad outlook on his other subjects cannot be over-estimated. How often is a student at school learning a language made to understand that that language has evolved? Or, worse still, how often is the school-child, working at some narrowly circumscribed period of history for the School Certificate examination, impressed with the fact that history *is* the evolution of mankind?

These, then, are the two main reasons why I consider biology should be a subject taught throughout the school and to all types of children. It is considered proper by all educationists that certain fundamental subjects such as arithmetic and English form an absolutely necessary part of any school curriculum. Has not the time arrived when it is just as important that the school-child, or the adult, for that matter, should know how his own body and his own society work as that he should know how to calculate compound interest or speak the king's English?

The views I have put forward are nothing more than ideal views. So long as schools are tied down and cramped in their style by having to conform to syllabuses of matriculation boards or standards of university scholarships, it is clear that it is not possible to devote the necessary time and teaching manpower to deal with biology as I have indicated. In 'modern' schools, however, where public examinations are not the determining factor in the teaching curriculum, there is some hope that a broad treatment of biology may be possible.

There is another and most important direction in which valuable biological teaching can be carried out, and that is in adult education. What I have said of

* Part of an address at a joint session of Sections D and L of the British Association meeting at Brighton on September 14.

the value of a biological outlook to the school-child applies *a fortiori* to the adult. But here again, extra-mural university teaching is largely bound up with the Workers' Educational Association. This excellent educational organisation, however, is hampered by the constitutional custom that the adult students *ask* for whatever classes they feel they want. As a result, adult education has come to be looked on as largely a development of the Faculty of Arts. The grown-ups ask for subjects such as psychology and economics, that naturally appear to them to bear directly upon their own lives. They do not realize that the subjects they choose are, as often as not, far beyond their mental capacity; in fact, as some of us think, they are beyond the capacity of the ordinary undergraduate. If they could be encouraged to study in a simple and broad manner the elements of biology, then a great step forward could be made in education generally.

CHROMATOGRAPHY FOR GENERAL CHEMICAL ANALYSIS

ORIGINALLY used for coloured substances, chromatography has been extended to deal with a wide range of colourless materials, by the use of suitable coloured derivatives or of indicators. Sugars and related substances form an important class of this kind, for which chromatography has proved to be a powerful analytical tool, particularly within the last ten years.

Messrs. Binkley and Wolfram* have themselves made important contributions to the subject, and their pamphlet appears at an appropriate time, when work in this field is expanding so rapidly; it provides carbohydrate investigators with an up-to-date historical review and practical details of the techniques involved. The first section of this pamphlet gives a simple general description of the adsorption chromatogram, with various details, such as selection of adsorbents, construction and operation of the chromatogram and location of zones after development. The second section provides a comprehensive review of the literature up to the end of 1947. Most of this section deals, of course, with adsorption chromatography, since it is only very recently that partition chromatography, particularly on paper, has been applied to the sugars. The third section describes with experimental details some of the applications of chromatography to sugars; for example, resolution and quantitative estimation of mixtures, purification, control in the production of technical sugar products and end-group assay.

Similar in size and presentation, "Introductory Notes on Chromatography"† covers a much wider field, including vitamins, alkaloids, chlorophylls, carotenoids, vegetable and mineral oils, amino-acids, inorganic ions and many other substances. Some of the applications are given detailed treatment in order to illustrate methods suitable for use in analogous cases. A useful list of references is given, most of which occur within the last ten years, and, as in the case of the first pamphlet, most of the chromatography described is of the adsorption type. This pamphlet succeeds in condensing a great deal of information into its forty pages and will be found useful as an introduction to the well-known text-books on chromatography.

Workers in both academic and industrial fields will find information of value in these two pamphlets, which are clearly written and attractively produced. Those who have not already adopted chromatographic techniques will be encouraged to do so after reading them. Chromatography may well prove to be indispensable in many investigations.

During the past year, the range of separations has been greatly widened by the partition chromatogram and by chromatograms which are neither clearly adsorption nor partition. Among recent advances in chromatography may be mentioned the use of dinitrophenyl derivatives of amino-acids and peptides, the use of radioactive isotopes, and the employment of new kinds of supporting media or modifications of existing media in partition chromatograms for the purpose of dealing with non-aqueous solvent systems. The present period is thus one of rapid development, and it is therefore desirable that information on the most recent advances in chromatography should be made available from time to time and with little delay. Perhaps this information might be issued in the form of pamphlets similar to those reviewed here.

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*"Chromatography of Sugars and Related Substances," by W. W. Binkley and M. L. Wolfram. (Scientific Report Series No. 10. Sugar Research Foundation, Inc., New York.)

†"Introductory Notes on Chromatography." (British Drug Houses, Ltd., Poole.)

NEW CHEMICAL LABORATORIES AT UNIVERSITY COLLEGE, DUBLIN

By PROF. T. S. WHEELER

THE honours degree courses in science in University College, Dublin, have recently been extended by one year so as to require four years of post-matriculation work. After three years, the student sits for a general degree examination in three subjects, and if he passes and attains an honours level in a subject is admitted to the honours school in that subject. A number of students, however, who wish to become chemists pass the general degree examination at a level in chemistry insufficient to qualify for admission to the honours school. For those and for other students, who though qualified for honours study feel attracted towards industrial chemistry, there has been instituted a course which extends over one year and leads to a diploma in chemical technology. To provide accommodation for the two types of fourth-year students two new chemical laboratories have been opened (see *Nature*, November 13, p. 768), the Ryan Laboratory for honours degree students and the Nolan Laboratory for those taking chemical technology.

The Ryan Laboratory commemorates the late Prof. Hugh Ryan, who was professor of chemistry in the College during 1899–1931 and who initiated honours degree teaching there. The laboratory has a floor area of 460 sq. ft. and will accommodate up to ten students; as formal lectures to honours candidates are limited to five per week, a large proportion of the students' time is spent in the laboratory. There is no specialization between the three main branches of chemistry in the fourth year, and in the Ryan Laboratory normal advanced work in inorganic and organic chemistry is carried out; practical physical chemistry is done in a special laboratory. Emphasis is

laid on quantitative inorganic analysis and on organic preparations involving modern methods of reduction, oxidation, condensation and so on. Short courses are also given on the application of semi-micro methods in both branches of chemistry. A reasonable variety of modern physico-chemical apparatus is available, the equipment including an absorptiometer (Spekker), a spectrophotometer (Coleman), microphotometer and spectroscope (Hilger), a chromatographic apparatus, an ultra-violet lamp and electrometric titration apparatus. A special feature is made of vacuum distillation; there are in the department molecular stills and various pumps, including a mercury pump combination (Towers) giving pressure of the order of 1 millibar. A laboratory fractionation column (Todd) has an efficiency of fifty theoretical plates. Each student gets an opportunity of making himself acquainted with the manipulation of the various pieces of apparatus.

The lecture courses and associated reading for the honours degree follow normal lines; electronic theory may perhaps be regarded as a special feature. The students attend a series of lectures extending throughout the year in which the quantum mechanics of the hydrogen atom, bond formation, the periodic table and atomic structure, and applications of electron theory in organic chemistry are discussed in some detail. It has been found that the three-year general course, which includes physics and mathematics to a good pass-degree standard, is useful to the student in reading modern theoretical chemistry.

Students who obtain an honours degree may enter the research laboratories to work for the M.Sc. degree; the work normally occupies one year. Various themes are studied; but at present the main work involves a study of the mechanism of base-catalysed reactions of the Claisen type with special reference to transformation reactions (see, for example, *Proc. Roy. Dublin Soc.*, **24**, 291; 1948).

The Nolan Laboratory (floor area 1,000 sq. ft.) is called after the late Prof. T. J. Nolan, who was professor of chemistry in the College during 1932–45. Prior to his comparatively early death, he had in conjunction with Prof. M. A. Hogan, professor of mechanical engineering, worked out the details of the course in chemical technology, but owing to the War was unable to make arrangements for the institution of the course. The laboratory contains apparatus to illustrate various unit chemical processes; this includes a centrifuge, a high-pressure (350 atmos. at 350°) autoclave of 5 litres capacity equipped with a stirring device and gas inlet (Cook), a 'Pyrex' glass fractionating column 3 ft. high, a steam-heated pan, a filter press, grinding equipment, high-temperature and vacuum ovens, and metering apparatus. Low-pressure steam and the other usual services are provided. The students receive lectures on the unit chemical operations which they study in the laboratory. At least half their time is spent in the Engineering Department of the College, where they have lecture courses on thermodynamics, materials of construction, workshop practice, fuel technology and electrotechnology. They also have practical instruction in the foundry, workshop, drawing office, and fuel and electrical laboratories.

In connexion with the planning of both the academic and industrial courses, it is desired to acknowledge valuable advice received from the heads of departments of a number of universities and colleges in Great Britain and from the Institution of Chemical Engineers.

PREHISTORIC FLOODING IN THE SOMERSET LEVELS

THE post-glacial history of the Somerset Levels has been the subject of considerable published work by Prof. H. Godwin and his collaborators in the pollen-analysis of peat; but a new series of "Studies of the Post-Glacial History of British Vegetation" reveals such a dramatic story as to appeal to more than specialists alone, although pollen-analysis and the study of macroscopical remains provide the scientific background of dating.

The unearthing and investigation of four distinct trackways through the raised bogs which lie between the Polden Hills and Wedmore Ridge are described in the first paper by Prof. A. R. Clapham and Prof. Godwin (*Phil. Trans. Roy. Soc. London*, B, 233, 233–273; 1948). Each is of particular interest, for, although appearing to be roughly contemporaneous, all represent different types of construction. The Meare Heath trackway is composed of transverse baulks of timber (mostly oak), many of which are perforated by mortise holes holding sharpened vertical piles. Long squared wooden stringers formed the margins of the track and indicate the use of wheeled traffic. The Shapwick Heath trackway, on the other hand, is of brushwood kept in place by stakes of various origins but including beech. Another trackway at Westhay is constructed from birch stems, the majority of which are laid longitudinally together with shaped, vertical stakes driven in to pin loose brushwood which prevented lateral displacement of the timbers. The shape of the axe-cuts on these timbers indicates a Late Bronze Age dating which is confirmed by other archæological remains. The Blakeway Farm trackway consists of overlapping faggots of very straight hazel poles which there is every reason to believe were derived from trees grown in a woodland system similar in its effects to present-day coppicing.

Each trackway was built upon the surface of a dry *Sphagnum-Calluna* bog; but in every case this appears to have been overwhelmed by flooding with the eventual formation of eutrophic *Cladium* fen. It is especially significant that they appear to have been submerged before suffering much hard wear, and a dramatic picture is drawn of the calamitous flooding of river- and lake-side colonies which caused a mass-evacuation over the improvised tracks.

The complementary paper by Prof. Godwin (*Phil. Trans. Roy. Soc. London*, B, **233**, 275–286; 1948) concerns the correlation between climate, forest-composition and prehistoric agriculture in the Somerset Levels. The most intense phases of agricultural activity appear to have occurred in the Middle and Late Bronze Ages and between Middle Iron Age and Middle Romano-British times, each being terminated by flooding of the raised bogs. Climatic change and not agricultural clearance is held to be the cause of changes in forest composition at the first flooding. The general nature of 'recurrence surfaces' is discussed, and it is pointed out that active bog-growth ceased in Romano-British times; but again this appears to have been the result of flooding by base-rich or brackish water and not an effect of Roman drainage schemes. The striking abundance of the remains of *Scheuzeria palustris* at the flooding surfaces contrasts strongly with its great scarcity at the present day (which is greater even than Prof. Godwin mentions, the species being extinct in

England according to a forthcoming paper by Dr. W. A. Sledge in *Watsonia*).

Finally, a probable Early Iron Age dating for the monoxylous 'Shapwick Boat' is based upon the pollen-analysis of a sample of peat taken from the boat, and rounds off very neatly these outstanding contributions to the history of primitive man and his environment in Somerset. H. G. BAKER

PLASTICS INDUSTRY IN SCOTLAND*

THE reconstituted Committee on Plastics appointed by the Scottish Council (Development and Industry) was appointed to inquire further into the extent to which the industry is being developed in Scotland to meet requirements, to suggest what further action is required to meet the situation, and to consider in particular the possibilities of meeting the basic requirements of the industry from raw materials in Scotland. In its final report, the Committee states that while more firms are now manufacturing finished materials from moulding powders obtained from elsewhere, and the engineering industry is in a position to tackle the highly specialized side of mould fabrication without difficulty, no developments of any kind have occurred in the manufacture of the ingredients of the moulding powders. No plastics industry can be firmly established in Scotland while these raw materials have to be imported, and the supply of coal-tar phenol and cresols is quite inadequate to meet the needs of the plastics and other industries of the United Kingdom.

The Committee recommends, therefore, that the Ministry of Supply be reminded of the urgent need for synthetic phenol, and that ample benzene and sulphuric acid are available in Scotland for the purpose. The supply of toluene is also adequate, and the sulphonation process is regarded as more attractive. Royal ordnance explosives factories in the west of Scotland appear to offer the most convenient sites for the manufacture of these phenols, and the Committee also recommends that the Director of Ordnance Factories should be informed accordingly. The Tar Research Association should be invited to explore methods for efficient recovery of such products as o-xylene and naphthalene for phthalic anhydride manufacture, and the Ministry of Supply should also be asked to consider the possibility of manufacturing methyl alcohol in Scotland as soon as the fertilizer situation is relieved.

The increasing use of plastics of the polyvinyl chloride, methacrylate and other types focuses attention on the unsaturated gases, acetylene and ethylene. The oil-refining and shale-oil industries could produce large volumes of ethylene and propylene in plant now available in Scotland, and the Committee accordingly recommends that the plastics and chemical industries should be advised that adequate amounts of unsaturated gases of the required purity for the manufacture of plastics and of antiseptics, insecticides, detergents and synthetic rubbers could be made available from the petroleum-refining and shale-oil industries and from coal carbonization in Scotland. [Ethylene could also be recovered from coke-oven gas without seriously affecting the calorific value of the gas for most industrial purposes, and the Committee recommends that the coke manufacturers be encouraged to investigate this possibility.

Since five per cent of the estimated power of the hydro-electric schemes set apart for calcium carbide manufacture would make a substantial contribution to the needs of the plastics industry in Scotland for acetylene, it is recommended finally that the Secretary of State be informed of the urgent need of an established carbide industry in Scotland for chemical as well as engineering purposes. The Committee concludes by pointing out that the rapidly increasing developments in the manufacture of flexible plastic materials emphasizes the need for a wide range of suitable plasticizers, none of which is at present made in Scotland.

The economic aspects of the whole situation are not discussed in this report; this may well draw serious criticism from the economists for neglect of an essential factor.

* Final Report of the Committee on Plastics: Plastics in Scotland. Pp. 16. (Edinburgh: Scottish Council (Development and Industry), 20 George Street, 1948.) 2s.

THE NATIONAL FOUNDATION FOR ADULT EDUCATION

THE National Foundation for Adult Education has now been constituted since January 1947 and, besides its quarterly bulletin, *Foundation Papers*, has published various supplements dealing with subjects of immediate importance to its corporate members.

One supplement, "Voluntary Agencies in Adult Education", contains a summary of the aims and activities of voluntary bodies working in the field of adult education. Since there is no up-to-date and comprehensive directory of adult education, the information contained in this supplement should be of particular use to local education authorities in coming to grips with the development plans for further education which they have been asked to prepare. "Voluntary Agencies in Adult Education" will also be useful as a reference for individuals who are interested in various aspects of adult education. The supplement contains no reference to the work of university extra-mural departments and tutorial class committees, and it is intended that these should be considered in a later supplement.

The second supplement, called "Sources of Visual Aid Material: For use in the Adult Teaching of History and Contemporary Affairs", has been compiled by the deputy director, Extra-Mural Department, University of Manchester. The information has been collected partly at the request of the Association of Tutors in Adult Education and partly to meet the needs of tutors of the Manchester University Extra-Mural Department. It should also be useful to leaders of discussion groups and others concerned with adult education classes. The booklet contains a list of maps and charts, films, filmstrips, lantern slides and other pictorial material which would be suitable for adult classes of a general historical and geographical nature, and also a list of material suitable for teachers dealing with particular periods and countries.

Another supplement, "Accommodation for Adult Education: Some Examples and Suggestions", discusses an issue which presents difficulties to all the co-operating parties in adult education. A recent pamphlet of the Ministry of Education stated that: "Up and down the country there are a few colleges

for further education which are housed in worthy buildings of dignity and beauty. But these are oases in the desert. For the most part there is a great dearth of educational accommodation of every kind from college to village hall, and further education, whether formal or informal, full-time or part-time, has at present to contend with most unsuitable premises." The National Foundation for Adult Education began in 1947 to collect information about the present availability of accommodation, and in this pamphlet it has brought together examples of improvisation at various levels, together with examples of more permanent provision. A short directory of the new short-term residential accommodation has also been included.

Because the literature about them is both brief and, in the main, out of date, some notes are included on the Cambridgeshire village colleges. These are one of the few working examples of combined educational provision, a subject which is being discussed in some detail to-day by the majority of local education authorities. The pamphlet should be useful in stimulating local education authorities and voluntary organisations to make a more searching examination of local possibilities for making more premises 'inter-available'. T. H. HAWKINS

FORTHCOMING EVENTS

Tuesday, December 28

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 3 p.m.—Sir Frederic Bartlett, F.R.S.: "The Mind at Work and at Play—Experiments in Psychology".
(Further Lectures on December 30, January 1, 4, 6 and 8.)

Wednesday, December 29

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 2.30 p.m.—Mr. James Fisher and Dr. Ludwig Koch: "Exploring Britain's Islands". (Christmas Meeting for Young People.)

Thursday, December 30

INSTITUTION OF CIVIL ENGINEERS (at Great George Street, London, S.W.1), at 3 p.m.—Mr. J. Melville: "Big Ships and their Docks—1, Building Big Ships". (Christmas Lectures to Boys.)
(Further Lectures on Monday, January 3, and Tuesday, January 4.)

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SENIOR RESEARCH OFFICER, and RESEARCH OFFICERS (3), in the Pasture Research Division of the Department of Agriculture and Lands, Southern Rhodesia—The Secretary to the High Commissioner for Southern Rhodesia, Rhodesia House, 429 Strand, London, W.C.2 (December 31).

SCIENTISTS (with University qualifications in one or more of the subjects of physics, chemistry, zoology, engineering, botany, agriculture, physiology and hygiene) as assistants to the Director (Science), Festival of Britain 1951—The Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting A.321/48A (December 31).

LECTURER IN THE ELECTRICAL ENGINEERING DEPARTMENT—The Clerk to the Governors, Woolwich Polytechnic, Woolwich, London, S.E.18 (January 1).

RESEARCH FELLOWSHIP IN THE DEPARTMENT OF CHEMICAL ENGINEERING AND APPLIED CHEMISTRY—The Secretary, Imperial College of Science and Technology, South Kensington, London, S.W.7 (January 1).

ENGINEER II (unestablished) at a Ministry of Supply Research and Development Establishment, to take charge of experimental work in testing explosives and demolition equipment, etc.—The Ministry of Labour and National Service, Technical and Scientific Register (K), York House, Kingsway, London, W.C.2, quoting E.569/48 (January 7).

PHYSICAL CHEMIST to take part in an investigation of tissue proteins and related problems—The House Governor and Secretary, Royal Cancer Hospital, Fulham Road, London, S.W.3 (January 11).

PROFESSOR OF ASTRONOMY—The Dean, Faculty of Science, Fouad I University, Cairo, Egypt (January 15).

GRADUATE with research experience in Organic Chemistry, for micro-analytical work, including teaching and research—The Registrar, The University, Liverpool (January 15).

SENIOR LECTURER OR LECTURER IN ANATOMY—The Registrar, The University, Sheffield (January 22).

CHAIR OF PHILOSOPHY in the University of Bern—Die Kantonale Erziehungsdirektion, Münsterplatz 3a, Bern, Switzerland (January 31).

DIRECTOR OF RESEARCH of the Australian Leather Research Association, Sydney—Mr. A. Harvey, Craigieburn, Duppas Hill Road, Croydon, Surrey.

BOTANIST in the East African Tsetse Reclamation Department, Kenya—The Director of Recruitment, Colonial Service, Colonial Office, Great Smith Street, London, S.W.1.

HONOURS B.Sc. PHYSICIST FOR RADIOTHERAPY DEPARTMENT—The Administrative Officer, Royal Berkshire Hospital, Reading, endorsed 'Appointment of Physicist'.

ENTOMOLOGISTS (2) IN THE DEPARTMENT OF AGRICULTURE, Kenya—The Director of Recruitment, Colonial Service, Colonial Office, Great Smith Street, London, S.W.1.

SOIL SURVEY OFFICERS (3) in the Gold Coast to supervise the collection of information about the soils of the forest region in that territory—The Director of Recruitment, Colonial Service, Colonial Office, Great Smith Street, London, S.W.1.

BIOCHEMIST to the Reading Group of Hospitals—The Administrative Officer, Royal Berkshire Hospital, Reading, endorsed 'Appointment of Biochemist'.

JUNIOR GRADUATE for biochemical work at Elstree, Herts—The Secretary, Lister Institute of Preventive Medicine, Chelsea Bridge Road, London, S.W.1.

CEREALIST for the Directorate-General of Agriculture, Government of Iraq—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1, quoting M.N.18187/3C.

PHYSICIST to investigate physical properties of dairy products, especially liquid milk—The Secretary, National Institute for Research in Dairying, Shinfield, Reading.

ASSISTANT ENGINEER OR TECHNICIAN to assist in the maintenance of several 200-kilovolt X-ray installations—The Secretary, Mount Vernon Hospital and the Radium Institute, Northwood, Middx.

PHYSICIST (preferably with some research experience) to study rheological properties of yarns and filaments—The Secretary, British Rayon Research Association, Bridgewater House, 58 Whitworth Street, Manchester 1.

TECHNICIAN (Grade II) IN THE DEPARTMENT OF CIVIL ENGINEERING—The Secretary, University College, Gower Street, London, W.C.1, quoting 'Civil Engineering/1'.

CHAIR OF ZOOLOGY—The Registrar, The University, Nottingham.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Question: a Journal. Edited by H. Westmann. Vol. 1, No. 1, July 1948: The Critical Problem in Human Relationships Today. By G. Wilson Knight, Herbert Read and Dr. J. H. Oldham. Pp. 87. (Published for the Present Question Conference, Ltd.) (London: Hammond, Hammond and Co., Ltd., 1948.) 2s. 6d. net. [238

The Identification of Textile Materials. (Handbooks of Textile Technology, No. 3.) Pp. 12+14 plates. (Manchester: Textile Institute, 1948.) 5s. [238

National Building Studies. Bulletin No. 2: Painting New Plaster and Cement. By H. M. Llewellyn and H. J. Eldridge. Pp. iv+21+9 plates. 1s. net. Special Report No. 3: Sand-Lime Bricks. By G. E. Bessey. Pp. v+58+3 plates. 1s. 3d. net. (London: H.M. Stationery Office, 1948.) [238

Ministry of Education and the Scottish Education Department. Ministry of Education Pamphlet No. 12: UNESCO and a World Society. Pp. 46. (London: H.M. Stationery Office, 1948.) 1s. net. [248

British Standard 1170: 1947. British Standard for Treatment of Water for Marine Boilers (with a Section on Engineering Factors). Pp. 96. (London: British Standards Institution, 1947.) 10s. 6d. net. [266

Other Countries

The Waipoua Forest: the Last Virgin Kauri Forest of New Zealand. By W. R. McGregor. Pp. 80. (Auckland: The Author, Department of Zoology, University College, 1948.) 5s. [238

Physics To-day. (Monthly.) Vol. 1, No. 1, May 1948. Pp. 40. (New York: American Institute of Physics, 1948.) 50 cents; annual subscription, 5 dollars. [238

Smithsonian Institution: United States National Museum. Bulletin 194: An annotated Checklist and Key to the Amphibia of Mexico. By Hobert M. Smith and Edward H. Taylor. Pp. iv+118. (Washington, D.C.: Government Printing Office, 1948.) 50 cents. [238

Annual Report of the All-India Institute of Hygiene and Public Health, Calcutta, 1944–45. Pp. viii+56. (Calcutta: All-India Institute of Hygiene and Public Health, 1948.) [248

International Chamber of Commerce. Brochure No. 126: Administrative Assistance for Tax Collection and Assessment (Council Resolution, June 1948); Report of the I.C.C.'s Committee on Taxation on the League of Nations Model Bilateral Convention (London Draft). Pp. ii+22. (Paris: International Chamber of Commerce, 1948.) [248

Catalogues

Murfume DDT and Azobenzene Smokes for Horticultural Use. Pp. 4. (Wheathampstead: Murphy Chemical Co., Ltd., 1948.)

Catalogue of New Books on Mathematics, Physics, Astronomy and Meteorology. Pp. 40. (London: H. K. Lewis and Co., Ltd., 1948.)

Catalogue of New Books on the Biological Sciences. Pp. 36. (London: H. K. Lewis and Co., Ltd., 1948.)

Airborne Beam-Approach Receiver *Type AD*86. (Ref. SL.37.) Pp. 4. BBC-Marconi Ribbon Microphone *Type AXBT*. (Ref. SL.36.) Pp. 8. 3 kW. Transmitter *Type TGM*651. (Ref. SL.35.) Pp. 4. Telegraphy-Telephony Transmitters *TGM* 571 and *TGS*571. (Ref. SL.17/2.) Pp. 4. Receiver *Type CR*300. (Ref. SL.4/2.) Pp. 4. Receiver *Type CR*100/2. (Ref. SL.1/2.) Pp. 4. (Chelmsford Marconi's Wireless Telegraph Co., Ltd., 1948.)